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THE GLACIATED AREA OF NORTH AMERICA.

BY REV. G. FREDERICK WRIGHT.

I AM asked to give, for the convenience of the readers of the NATURALIST, a brief summary of the present results of my glacial investigations during the past ten years. This I am enabled to do more concisely because of the plates which I am permitted by my publisher to use so freely.¹

The special marks characteristic of the glaciated region consist of striated rocks, striated pebbles, transported boulders and an unstratified deposit called "till." These are now too familiar to need description. My investigations have chiefly had in view the determination and study of the southern boundary of the glaciated area in Eastern United States. I have zigzagged the whole boundary from the Atlantic ocean to the State of Illinois, the results being given in the accompanying plates, the correctness of which the reader may readily verify for himself, for when one has become once familiar with the glacial signs indicated above, he cannot fail to notice their conspicuous absence south of the boundary line indicated.

It will be observed that in New England the rivers reach the sea inside the glacial limit, and they are all characterized throughout their whole extent by terraces of coarse gravel, varying

¹For fuller details of my work see Proceedings of the Boston Society of Natural History, Vol. XIX, pp. 47-63, Vol. XX, pp. 210-220, Vol. XXI, pp. 137-145; Geological Report of New Hampshire, Vol. III, pp. 167-170; *American Journal of Science*, Vol. CXXI, pp. 120-123, Vol. CXXVI, pp. 44-56; AMERICAN NATURALIST, Vol. XVIII, pp. 563-567; but especially my "Studies in Science and Religion": Andover: W. F. Draper. 1882, pp. 256-350, and the "Glacial Boundary in Ohio, Indiana and Kentucky": Cleveland: Western Reserve Historical Society. 1884, pp. 86; Ohio Geological Report, Vol. V, pp. 750-771.

in height from a few feet to one hundred or more feet above the present flood-plain. These are now shown to have been deposited during the last stages of the glacial period by the "immense spring freshets" which marked the melting away of the vast body of ice. Many of these gravel deposits, however, are un-

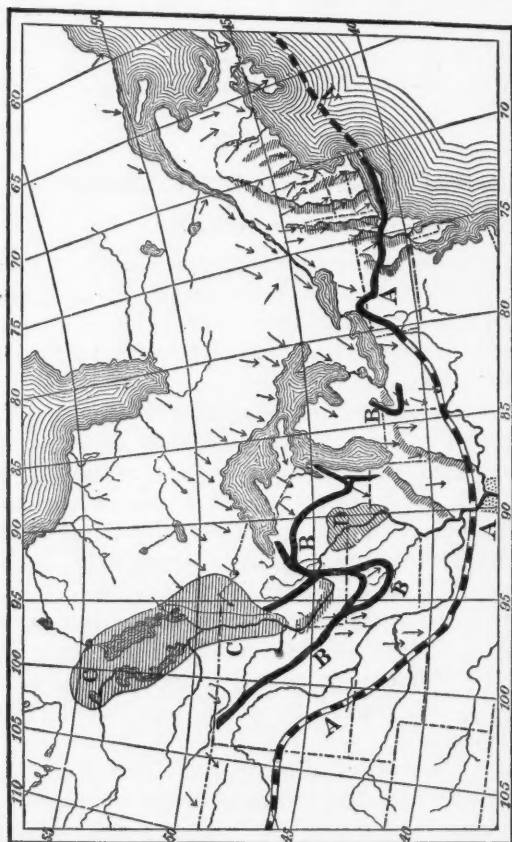


FIG. 1 (taken from the author's "Studies in Science and Religion") shows a portion of the glaciated area of North America. AA represents the boundary of the glaciated area. The continuous line is from actual survey in 1881. (For completion to Illinois see Figures 4 and 10. The broken part is still somewhat conjectural.) BB marks special glacial accumulations. CC represents Lake Agassiz, a temporary body of water formed by the damming up by ice of the streams flowing into Hudson's bay, the outlet being, meanwhile, through the Minnesota. D is a driftless region which ice surrounded without covering. The arrows indicate the direction of glacial scratches. The names of New England and the terraces upon the Western rivers are imperfectly shown upon so small a map.

connected with present water-courses, but run across the country for scores of miles in long, tortuous systems of gravel ridges from a few feet to one hundred feet above the valleys in which they are situated. These are now called "kames," and correspond to "åsars" in Sweden, and were evidently formed contemporaneously with the terraces.

West of New Jersey streams are continually encountered whose sources are in the glaciated area, and whose mouths are in the unglaciated. Fig. 2 illustrates this in the case of the Delaware, which is of special interest because the glacial terraces

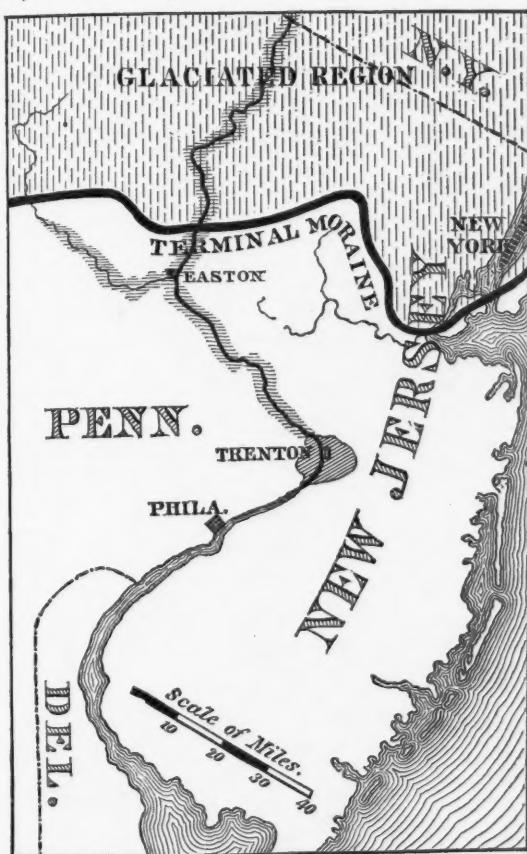


FIG. 2.—This cut (taken from "Studies in Science and Religion") shows, in addition to the glaciated area of New Jersey, the glacial terraces of gravel along the Lehigh and Delaware rivers, and also the "Delta terrace" at Trenton, fifty feet above the river, in which Dr. C. C. Abbott has found palæolithic implements.

can be traced continuously down the river from the boundary line to a "delta terrace" of large extent at Trenton, whose surface is fifty feet above the present flood-plain. It is in this glacial terrace that Dr. C. C. Abbott has found so many palæolithic im-

plements.¹ Professor Cook has also found in these same glacial gravels the tusk of a mastodon. In riding from New York to Philadelphia on the New Jersey Central railroad, the train passes

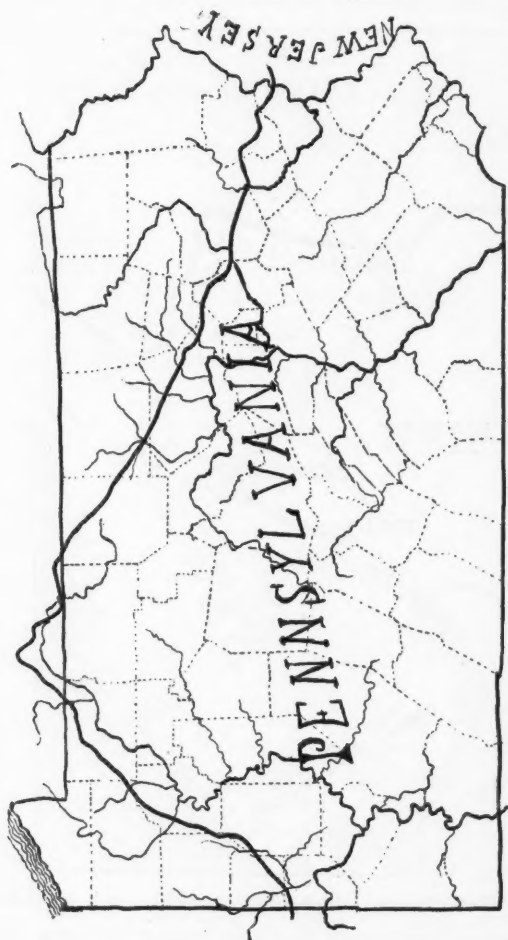


FIG. 3.—The broad, black line shows southern boundary of glaciated area of Pennsylvania. This and the remaining figures are from the "Glacial Boundary in Ohio, Indiana and Kentucky," published by the Cleveland Historical Society.

from the glaciated to the unglaciated region at Metuchen, and on the Bound Brook route at Plainfield, and in both cases the boundary line is marked by extensive accumulations of gla-

¹ See his "Primitive Industry," Salem, Mass., 1881.

ciated material rising in hills from thirty to seventy feet in height.¹

Fig. 3 shows the boundary line across Pennsylvania with a remarkable bend to the north as it crosses the Appalachian mountains, passing through Northampton, Monroe, Luzerne, Columbia, Lycoming, Tioga and Potter counties, thence through Allegheny and Cattaraugus counties in New York, thence back again in Pennsylvania through Warren, Venango, Mercer and Lawrence counties.²



FIG. 4.—Map showing southern boundary of glaciated area of Ohio.

In Fig. 4 the dotted portion shows the glaciated area of Ohio.

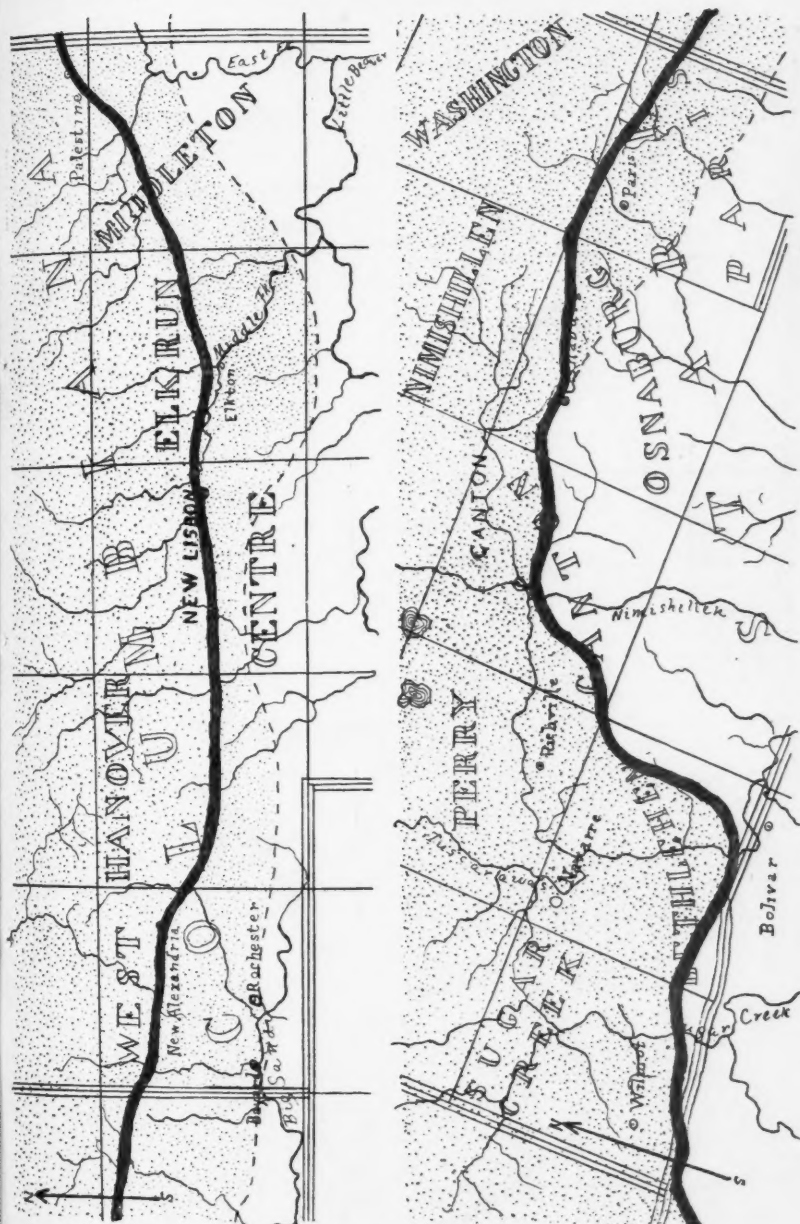
¹ For details respecting the boundary in New Jersey, see the report of Professors Cook and Smock for 1878, 1879, 1880.

² For details see the joint report of Professor H. Carvill Lewis and myself, soon to be issued by Professor Lesley as a part of the State geological report.

The accompanying list of counties is numbered to correspond to those in the plate :

1. Williams.	23. Hardin.	45. Pike.	67. Muskingum.
2. Defiance.	24. Logan.	46. Adams.	68. Morgan.
3. Paulding.	25. Champaign.	47. Sciota.	69. Athens.
4. Van Wert.	26. Clarke.	48. Erie.	70. Meigs.
5. Mercer.	27. Greene.	49. Huron.	71. Gallia.
6. Darke.	28. Clinton.	50. Lorain.	72. Lake.
7. Preble.	29. Brown.	51. Richland.	73. Geauga.
8. Butler.	30. Ottawa.	52. Ashland.	74. Portage.
9. Hamilton.	31. Sandusky.	53. Knox.	75. Stark.
10. Fulton.	32. Seneca.	54. Licking.	76. Tuscarawas.
11. Henry.	33. Wyandot.	55. Fairfield.	77. Guernsey.
12. Putnam.	34. Crawford.	56. Perry.	78. Noble.
13. Allen.	35. Marion.	57. Hocking.	79. Ashtabula.
14. Auglaize.	36. Morrow.	58. Vinton.	80. Trumbull.
15. Shelby.	37. Union.	59. Jackson.	81. Mahoning.
16. Miami.	38. Delaware.	60. Lawrence.	82. Columbiana.
17. Montgomery.	39. Madison.	61. Cuyahoga.	83. Carroll.
18. Warren.	40. Franklin.	62. Medina.	84. Harrison.
19. Clermont.	41. Fayette.	63. Summit.	85. Jefferson.
20. Lucas.	42. Pickaway.	64. Wayne.	86. Belmont.
21. Wood.	43. Ross.	65. Holmes.	87. Monroe.
22. Hancock.	44. Highland.	66. Coshocton.	88. Washington.

The five figures numbered 5, 6, 7, 8, 9, give the section that I have zigzagged through Ohio on the scale of six miles to the inch. Upon the first two plates I endeavored to represent the boundary of what Professor Lewis and myself called the "fringe"; the broad dark line representing the limit of the more considerable glacial deposits, the broken line the extreme limit of glacial boulders out of reach of the water courses. West of Stark county I did not think it best to draw this distinction, and my line marks the extreme limit of true glacial action. It will be interesting and important for other investigators to examine the fringe throughout the whole line, and inquire why in some places it is so broad and in other places there is none at all. Glacial deposits of special amount are found at the following places at or near the margin in Ohio: Columbiana county—Palestine, the northern part of Centre township, and New Alexandria; Stark county—two miles south-west of Canton, north of Wilmot; Holmes county—a little north of the line throughout; Knox county—Danville, Millwood, Bladensburg; Licking county—Wilkin's run, Newark, Amsterdam; Perry county—Thornville; Fairfield county—Rushville, the vicinity of Bern station, Lan-



Six miles to an inch.

FIG. 5.—Glacial Limits in Ohio.

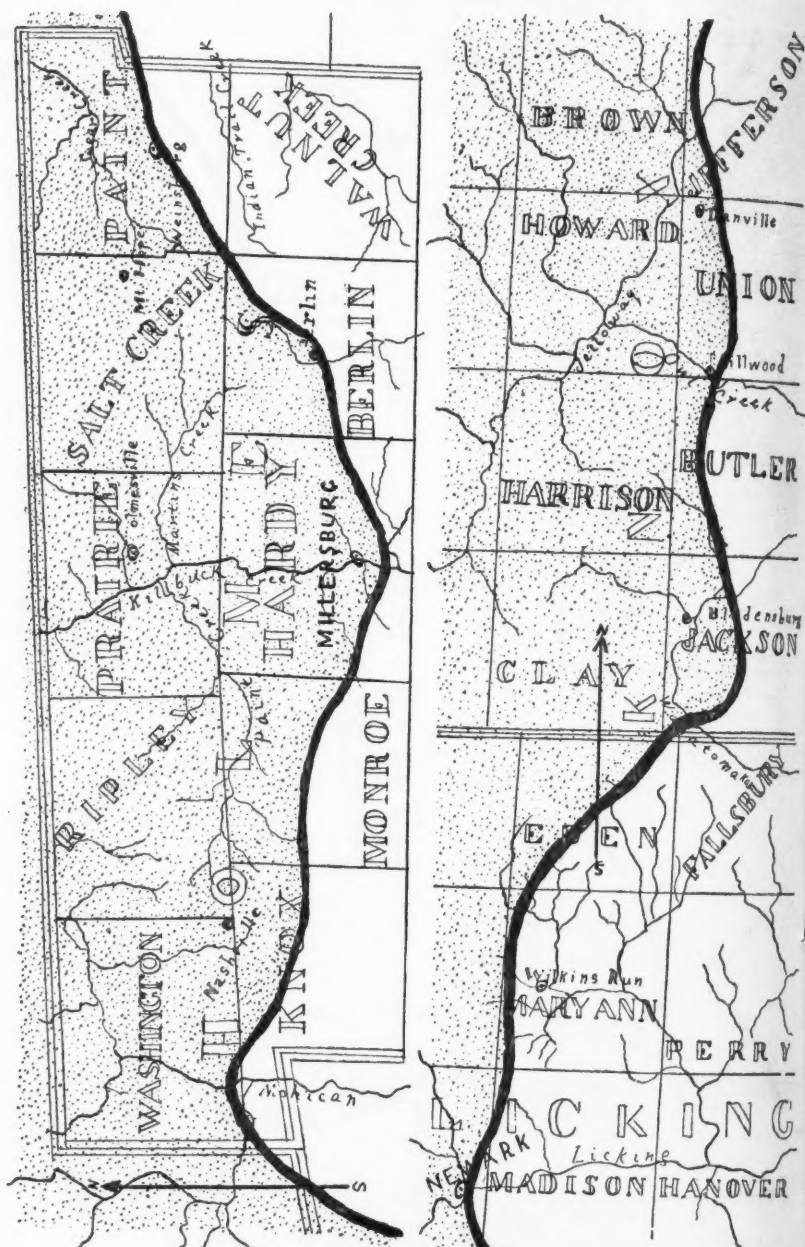


FIG. 6.—Glacial Limits in Ohio.

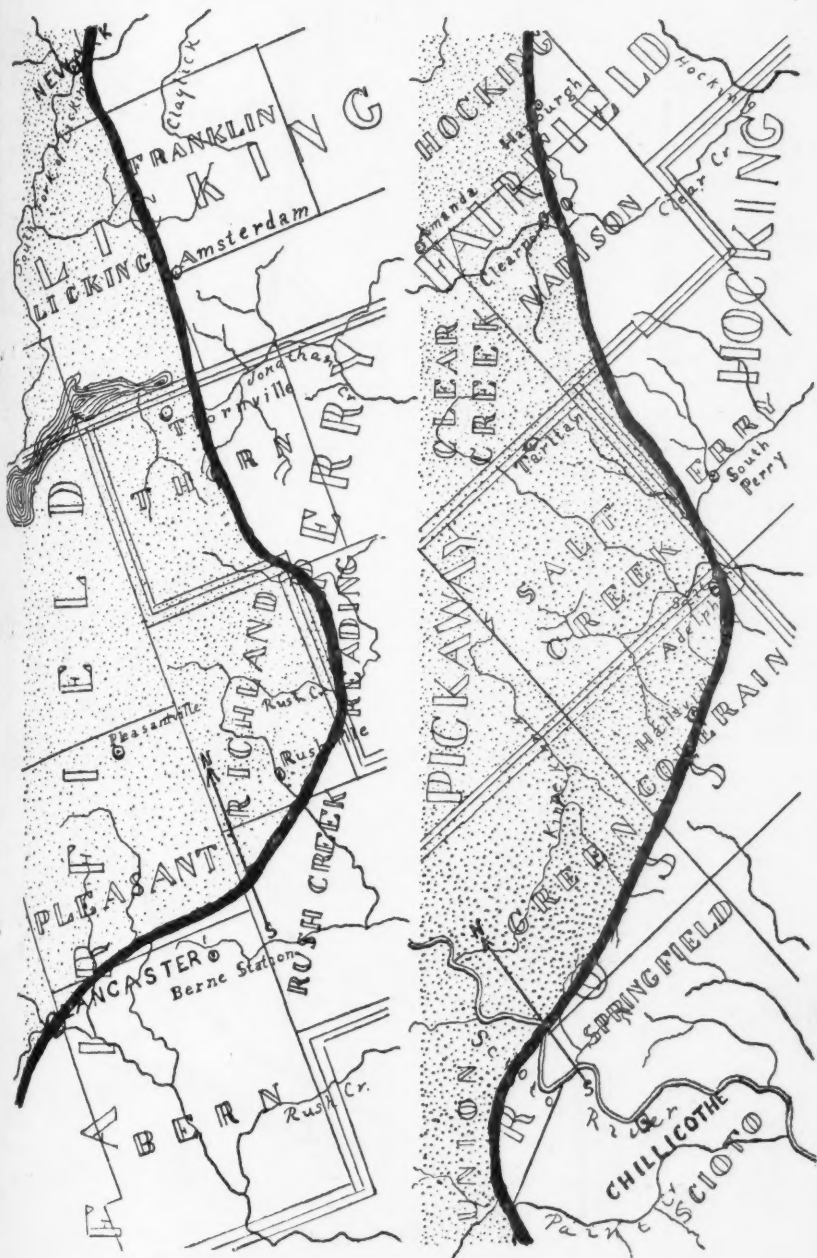


FIG. 7.—Glacial Limits in Ohio.

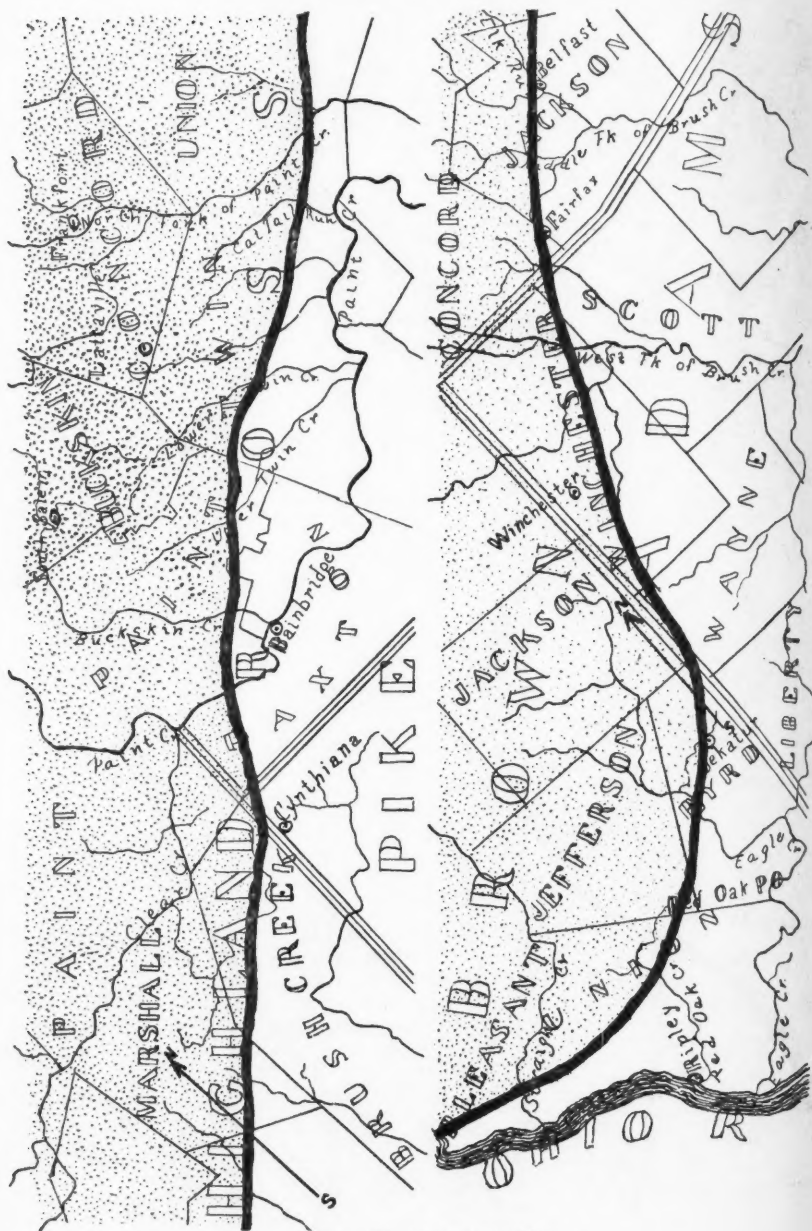


FIG. 8.—Glacial Limits in Ohio.

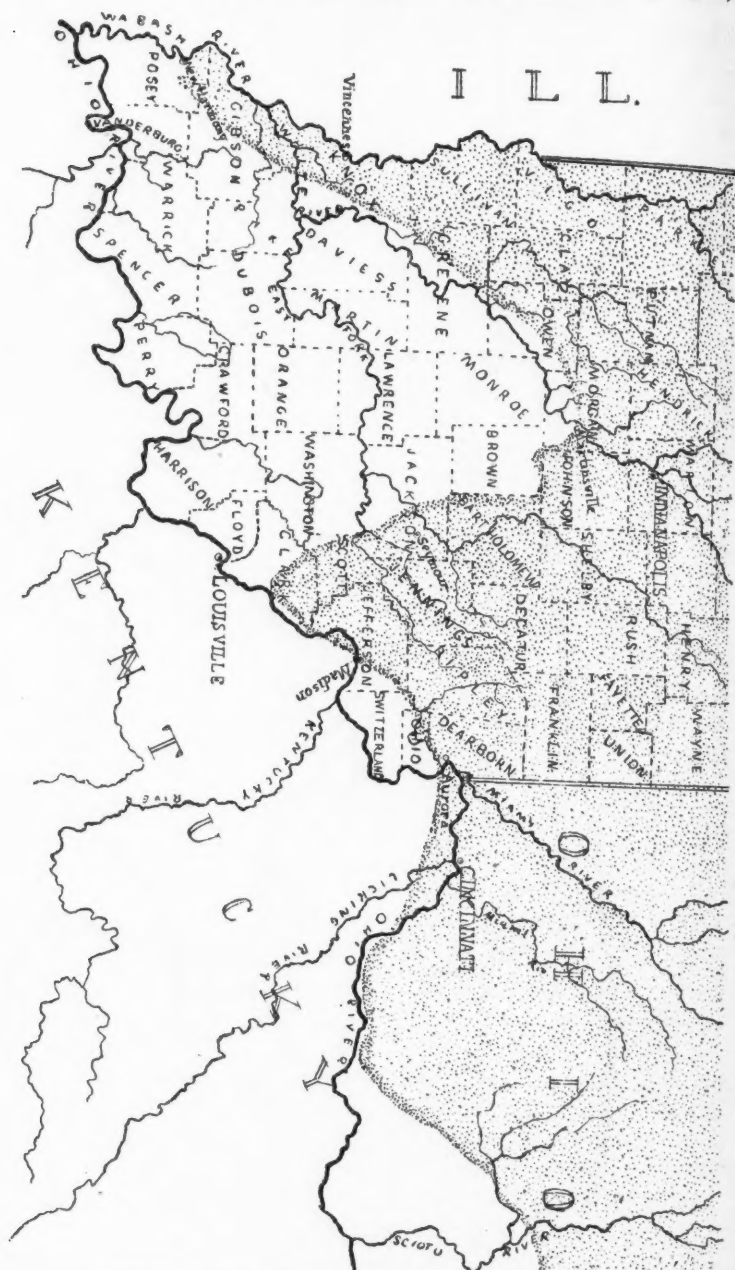


FIG. 10.—Map of Southern Indiana, showing glacial boundary.

caster and Clearport; Pickaway county—Tarlton; Ross county—Adelphi, Hallsville and throughout Green, Union, Concord and Buckskin townships; Highland county—in Paint and Northern Marshall townships; Adams county—the vicinity of Winchester; Kentucky—in the vicinity of Carthage, Burlington and Woolpers creek.

Figure 10 shows more distinctly the relation of the glacial limit to the Ohio river at Cincinnati, producing the supposed ice dam discussed in a previous number of the *NATURALIST* (see Vol. XVIII, June, 1884, pp. 563-567), and the line across Indiana traced by me last summer. The northern part of Dearborn, the whole of Ripley, Decatur, Jennings and Bartholomew counties are deeply covered with true glacial drift, and the extreme limit is pretty easily ascertained, though the deposits in Jefferson, Clark and Scott counties are scanty as compared with the counties farther north. The highest point of the State is in Brown county, 1150 feet above the sea. The ice deposits do not reach to that point, but are very deep and extensive a few miles north over the southern part of Johnson county. In Owen county there are numerous striæ running 50° east of south, or nearly at right angles to the glacial limit. The glacial deposits in Southwestern Indiana are covered with "loess," which is doubtless a water deposit, and will, to the westward, probably greatly increase the difficulty of tracing the exact southern boundary of the glaciated area.

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ON THE EVIDENCE THAT THE EARTH'S INTERIOR IS SOLID.

BY DR. M. E. WADSWORTH.

(Continued from page 686, July number.)

Conclusions.—Starting with the common belief that the earth was once an intensely hot gaseous body, it follows that when cooled from a gaseous to a liquid state, convection would cause the intermingling of all the liquid portions only so long as the heat kept every part at the same density. As soon as an especial difference in density manifested itself (if it had not already done so in the gaseous state) the heavier materials would sink towards the interior and the lighter pass outward towards the exterior. So soon as these materials became viscous the inter-

change would be retarded. Now, when convection no longer caused the heterogeneous materials of the earth to mingle, the cooling rate would change from the comparatively rapid rate of convection-cooling to the very slow rate of cooling by the conduction of liquids.

It is to be remembered that to have convection in liquids at all there must be some external source which shall, at some point, continually supply an increment of heat, but for a cooling globe no such supply exists. These are facts that ought to be taken into account in all discussions relating to the age of the earth or sun.

It would seem, however, that Thomson's view of the age of the earth is based upon the supposition that the earth during its liquid state was homogeneous and cooled throughout by convection, and that later it became solid and likewise cooled by the ordinary conduction of a solid body.

The writer would hold, in contradistinction, that after the earliest stages the liquid earth cooled by conduction in a heterogeneous liquid, and after the superficial crust was formed, by conduction not only through a heterogeneous liquid, but also a heterogeneous and, at least in its exterior portion, a more or less discontinuous or fragmental solid. In this way it would seem as if biologists might gain a portion, if not all, the time desired, which is now denied them by the physicist.

In the same way, if the heavier gases tend to lie nearest the center in a hot gaseous body, the exceedingly slow rate of cooling on account of the poor conductivity of gases ought to be taken into account in all discussions relating to the age of any body formerly gaseous. Another factor would be the heat disengaged by the chemical unions necessary to form the mineral combinations, now existant on the earth, out of the once disassociated gases.

But to return; when the lighter surface material of the earth had cooled sufficiently, a crust would be formed which, owing either to its lighter state in its hot condition, or to its scoriaceous character and the viscosity of the material beneath, would not sink. It is to be remembered that on account of the passage of rocks through the softened or viscous state to the solid, that the viscous material immediately below the solid crust would be in nearly the same condition and temperature as the overlying crust

into which it would gradually pass. It is not probable that the crust would break up and begin to sink, because even if its surface grew cold it would always have this hot, solid base, lighter than the underlying viscous liquid, which, owing to the increasing specific gravity as the interior was approached, would probably be more dense than any of the overlying cold crust.

Even if the crust should become heavier, break up and begin to sink, this sinking would be very slow on account of the viscosity of the liquid and its constantly increasing density, while the heat imparted to the sinking crust would tend to bring it to about the same specific gravity as the liquid, as the sinking mass neared its melting point. But above and beyond all, it would soon reach a point at which the liquid, being of different composition, had a higher specific gravity than the crust, and no farther sinking could take place. We should thus expect to have formed on the earth's surface a crust which never would sink, or if it sank at all, would for only a comparatively short distance, giving rise at that point to a solid crust floating upon a denser heterogeneous liquid. While willing to admit that the crust when cold would be heavier than the liquid out of which it was formed, it is denied that the exterior would cool to such an extent as to be heavier until solidification had taken place to sufficient depth to render the contraction of the exterior portion of but little effect; that is the increased density of the liquid immediately beneath the hot lighter interior portion of the crust would more than counterbalance the increased density of the cold exterior portion of that crust.

Sir William Thomson's idea of a crust on solidification sinking to the center of the earth and building up a honey-combed mass, is only applicable to a homogeneous liquid globe of but slight viscosity, whose material contracts in passing from the liquid to the solid state.

In such a condition of the earth as the writer supposes, a gradual passage from the cooled surface crust towards the hotter interior portions of that crust, thence into the plastic and viscous condition, no opportunity would exist for the generally supposed shrinking away of the nucleus from the rigid crust, but the entire earth would contract as a whole, causing a linear shortening of the crust through compression. This would occasion a crushing together of this crust, causing it to be depressed in some

places and elevated in others. The depression of any portion of the crust into the viscous liquid beneath would cause the elevation of an equivalent weight of the liquid material; as in the case of ice, the depression of the ice on one side causes the heavier water to overflow unless it can escape in some other direction. The simple sinking of a portion of the crust on one side with its corresponding but less elevation on the other, with the attendant fissuring, affords all the dynamic agent needed to raise lavas to the top of the highest mountains;¹ while if in any way the yielding to the lateral compression should be sudden, instead of gradual, owing to fracturing and slipping of the parts, an earthquake shock would result.

If the general views of the compression of the material in the interior of the earth are correct, then if from any cause the pressure were removed, the natural expansion of the material, if liquid, would cause it to rise to some extent in any vent or opening.

During the earlier times when the crust was thinner and the internal heat stronger, a greater variety and amount of materials raised as lavas through the fissures would be expected, and not improbably outflows of two different kinds might take place at the same time, as it would seem had taken place on Lake Superior.

The up thrust of the still liquid and yielding interior portions through the fissures in the overlying crust, and the subsequent solidification of the intruded material, would cause that crust to be tied through and through with the underlying mass.

Neither is it to be expected that the contraction would be equal in every portion, while the depression of the crust into the interior would give rise to unequal thicknesses of that crust, to which the liquid outflows would add. The great irregularity of the under surface of the crust, coupled with the gradual passage from the solid to the viscous liquid interior would conspire to prevent any of the supposed slipping of the crust over the interior, as many physicists have assumed would take place if the earth had a liquid interior.

If it is held that volcanic rocks are derived from the re-liquefaction of the original crust of the earth, would not the best theory be, in the light of what is now known of the behavior of

¹ Whitney, "Earthquakes, Volcanoes and Mountain-building," p. 90.

rocks on their solidification, that increased pressure, brought about by contraction of the crust in cooling or by sediments deposited on a sinking area, or by some other cause, produce a lowering of the fusing point, as in the case of ice, and thus enable the natural heat of the rocks themselves to cause their passage into the liquid state ?

It has been claimed with apparent justice that the simple depression of any portion of the earth's crust into the still liquefied portion of its interior, would tend to cause the base of the depressed portion to re-liquefy through the greater heat to which it would be then subjected to, thus making the re-fusion the natural result of the earth's contraction.

It appears to the writer that so far as any evidence now exists regarding the earth's interior, it is allowable to assume its present liquid state. A state that in his judgment accords better with the facts of petrography than any other assumption that has been made.

It is true that if the materials of the earth's interior were solid, but could be liquefied by diminution or increase of pressure, this liquefaction would perhaps be consonant with what is now known of the internal structure of rocks, especially the partial dissolving of the olivine of basalts, the hornblende of the andesites, the quartz of the rhyolites, etc. One of the greatest difficulties in the way of this supposition is to understand why the same lava should produce different crystals when it was in the interior from those yielded on the exterior of the earth.

It is difficult to see how, if the earth is solid, that any relief from pressure could take place otherwise than from the crushing together of the overlying rocks, the tearing up of these from the underlying ones, and elevating them into the air ; that is, the relief from pressure would come from an elevating instead of a sinking process. In truth it would seem that eruptions and mountain building or elevations arose rather from the sinking of large masses causing smaller ones adjacent to rise, or, as announced by Dana, the highest border is on the side of the greatest ocean.¹ It would seem that elevation followed subsidence, instead of subsidence following elevation. If this is the case, it is difficult to explain how subsidence could be brought about first in a *solid* globe.

¹ "Man. Geol.," 1880, p. 28.

We cannot imagine that matter so rigid as the earth's interior is claimed to be, could yield to the pressure of sediments, glaciers or lava flows, as has been advocated. This view is based chiefly on the fact that areas of thick detrital formations must have been areas of subsidence, hence, it is argued, the deposit itself has been the cause of the sinking. The reverse appears rather to be true, that only areas of extended subsidence can be areas of great deposition. May it not then be claimed that the subsidence was the cause of the deposition instead of the deposition being the cause of the subsidence; and is not the former view more natural than the latter?

The deposition of sediment in any locality requires that one portion of the earth's crust should be lower than another. In the theory of a solid globe this would be brought about by the elevation of a portion of the crust, while in the theory of a liquid globe by the depression of a portion of that crust.

In a viscous mass, such as the earth's interior next the crust is here supposed to be, coupled with the irregular thickness of the crust, no especial connection could be expected to exist between different vents, even if near one another, until after the lapse of considerable time—the viscosity itself preventing any rapid motion of the interior mass.

Whatever water was met, on the welling up to the surface of the lava, would naturally render the latter more liquid, so far as it entered into the lava. The intervention of water in a volcanic eruption seems to be mainly its action on the lava during its passage upwards, instead of its being the cause of the eruption. It, indeed, plays a striking rôle in volcanic phenomena, but it does not seem to be the *primum mobile*. It is difficult to see how lava in ascending to the earth's surface could reach it without meeting water somewhere on its way. When the water was met could the results be different from those now witnessed? Does it not seem that water is the accident rather than the cause of the eruption, and do not most observers transform an effect into a cause?

It may be said that the physical evidence advanced in behalf of its essential solidity is violated by the premises and limitations chosen as the basis of the mathematical discussion; while the petrographical and geological facts demand either an interior that is liquid or one that can readily become so.

It may indeed be said with Professor Dana: "Among geological facts none appears to demand for its explanation a rigid globe. The demand has come through the supposed requirements of physical laws, studied with the aid of the highest mathematics, whose methods and conclusions are sure only when all the modifying conditions of the problem are thoroughly understood.

"It is now admitted by some of the best of physicists that no arguments have yet been presented which prove the earth to be a rigid globe, or to have a rigid crust a thousand miles or so thick; and it is also admitted by some mathematicians and physicists of eminence, including Airy, the astronomer royal, that the hypothesis of a thin crust over a liquid interior is probably the true one.

"The science of geology is, therefore, free to adopt the conclusion which seems best to suit known facts."¹

For further discussions of the state of the earth's interior the reader is referred to

Barnard's papers, "On the Internal Structure of the Earth considered as affecting the phenomena of Precession and Nutation," Smithsonian Contributions, No. 240, pp. 33-48; No. 310, 16 pp.

Whitney's "Earthquakes, Volcanoes and Mountain-building," 1871, pp. 68-107.

Fisher's "Physics of the Earth's crust," 1881.

Dana's "Manual of Geology," 3d ed., 1880, pp. 808-812.

Green's "Physical Geology," 2d ed., 1877, pp. 484-524.

J. H. Pratt, *Nature*, 1870, II, 264, 265; 1871, IV, 28, 29, 141, 344, 345; *Geol. Mag.*, 1870 (I), VII, 421-424; *Phil. Mag.*, 1859 (4), XVII, 327-332; XVIII, 259-262, 344-354; 1860, XX, 194-196; 1862, XXIV, 409-417, 507-508; 1863, XXVI, 342-346; 1866, XXXI, 430-435; XXXII, 17-22, 313-315; 1867, XXXIII, 10-16; 1870, XL, 10-14; 1871, XLI, 307-309; XLII, 89-103, 280-290, 400.

Henry Hennessy, *Nature*, 1871, IV, 182, 183.

A. H. Green, *Nature*, 1871, IV, 45, 46, 383, 384.

O. Fisher, *Geol. Mag.*, 1870 (I), VII, 535, 536.

M. H. Close, *Geol. Mag.*, 1870 (I), VII, 537.

David Forbes, *Nature*, 1871, IV, 65; III, 296-299.

A. J. M., *Nature*, IV, 45, 366.

C. E. Dutton, *Penn Monthly*, 1876, VII, 364-378, 417-431.

Cordier, *Edin. New Phil. Jour.*, 1827-28, IV, 273-290.

Leslie, *Ibid.*, 1828-29, VI, 84-89.

E. W. Hilgard, *Am. Jour. Sci.*, 1874 (3), VII, 535-546.

Mallet, *Phil. Trans.* 1873, pp. 147-227; 1875, pp. 1-9.

Judd, "Volcanoes," *New York*, 1881, pp. 307-330.

Peirce's "Ideality in the Physical Sciences."

Winchell's "World Life," etc., etc.

¹"*Man. Geol.*," 1880, p. 812; see also Whitney's "Earthquakes, Volcanoes and Mountain-building," 1871, p. 74.

ON THE SHEDDING OF THE CLAWS IN THE PTARMIGAN AND ALLIED BIRDS.

BY LEONHARD STEJNEGER.

THE fact of the ptarmigans shedding their claws regularly every summer, seems not to have been observed personally by any of the many excellent American ornithologists, and has, therefore, been comparatively little known to them. It may consequently not be without interest to demonstrate this process, as I have material at hand which shows the procedure very plainly.

The late Professor Sven Nilsson, the famous Swedish zoölogist, was the first to discover this peculiarity in the ptarmigans. His countryman, Professor W. Meves, afterward confirmed his observations, and at the same time proved that this singular shedding of the claws also occurs in other birds of the family Tetraonidæ, as, for instance, in both sexes of *Bonasa bonasia*, *Urogallus urogallus*, and also, in the female at least, of *Lyrurus tetrrix*.

As will be seen in the specimens of the *Lagopus ridgwayi* (a new species which I was fortunate enough to detect on the Commander islands, near Kamtschatka), shot in June and August, before shedding, the middle claw measures 18-20^{mm}, while in the specimen shot on the 23d of August, and which has just thrown the old ones off, the length of the new claw is only 11^{mm}. More instructive still is a male, shot on the same day, as it has the claws only partially shed. The old claws have become loosened from their base and are forced 2-3^{mm} out, still covering the tip of the new ones, except on two toes, from which they have already dropped off. Hence it is obvious that the process is not a pathological one, in which the nail drops off as soon as it is perfectly separate from its bed, and has ceased to receive nourishment through the blood-vessels.

Most conclusive however, is a specimen of a quite different species, *Lagopus alba*, a specimen collected by Dr. Bean, on Unga, one of the Shumagin islands, Alaska. About this specimen Dr. Bean remarks in his "Notes on Birds collected in Alaska," etc., in the Proc. U. S. Nat. Mus., 1882, p. 163, as follows: "This specimen (shot on July 21st) corresponds very closely in most respects with number 33,548, a female from Norway, collected July 2,

Read before the Biological Society of Washington, April 5th, 1884.

1862; the claws, however, are considerably shorter than in the Norway example, and in all other specimens of *albus* in the Museum." Dr. Bean was kind enough to show me the specimen, when it was apparent that the extreme shortness of the claws was due to the fact that the bird had shed them just before it was shot, except on the right outer toe, on which the nail was so loose, however, that it dropped off, as I was a little too rough in handling it.

It will thus be seen that the shedding takes place in July or August, according to locality and other circumstances, at the time when the toes are most denuded—in fact almost wholly naked—and the dark summer plumage is most complete. The claws grow very rapidly, however, and reach their full length long before the white winter-plumage with the densely clothed toes is fully developed.

So far as known, this process is confined to the members of the family of Tetraonidæ, mentioned above, when in the wild state, but Collett, in Christiania, has mentioned a case where a quail (*Coturnix coturnix*) shed its claws in confinement, but this may have been due to some pathologic process.

I am not aware that this peculiarity has been observed in any of the American Tetraonidæ, except *Lagopus alba*, but there seems to be no reason why it should not occur, at least in species living under conditions similar to those in Northern Europe, and Northeastern Asia. It is to be expected that we will soon hear of instances from this Nearctic region also, when attention has once been directed to it.

No histological investigation has been made to ascertain the causes and the development of this unusual process (at least I am not aware that any results of such an investigation have ever been published), and consequently nothing is definitely known.

As to the use which the birds derive from this extraordinary elongation of the claws, I shall only quote Professor Meves. He wrote in 1871¹ as follows: "They (*Lagopus* and *Tetrao*) have, all through the winter, to struggle with the snow upon which they are forced to walk. The snow is often loose, and with a foot like that of the common fowl, they would need much greater exertion of their strength in order to keep themselves on the surface. But as the ptarmigan by having the underside of the

¹Öfr. Sv. Vet. Acad. Förhandl., 1871, p. 772.

toes thickly coated with feathers, which can be spread out, and by means of the long and straight claws—which may be compared with snowshoes—are enabled to run easily over the snow, the usefulness and the necessity of the lengthening of the nails is self-evident. In the genus *Tetrao* (= *Urogallus* + *Lyrurus* + *Bonasa*) the lateral horny fringes of the toes render the same excellent service, and may fitly be regarded as a kind of snowshoes. *During the summer this whole outfit becomes superfluous*, which may be the main cause of the periodical shedding." It may in this connection be mentioned, that the horny fringes in *Tetraones*, and the thick feathering of the toes in *Lagopodes* also moult during the summer, at which time the toes of the latter are almost wholly denuded of feathers.

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ON THE CONSTITUTION OF SOME APPENDAGES OF THE MOLLUSCA.

BY W. H. DALL.

IT is comparatively recently that the organic chemists have devoted any time to the investigation of the constitution of invertebrate organs or appendages, especially among brachiopods and mollusks. In the rare cases in which this has been done the observations in many cases were overlooked by the biologists most interested, and the occurrence of phosphate of lime in the shells of certain brachiopods is almost a singular instance where the statement of such a fact has penetrated all the manuals and text-books.

The teeth and radula of mollusks, an apparatus extremely characteristic of several classes of that sub-kingdom, and upon which classification has been largely based for at least thirty years, are commonly referred to in the text-books as "silicious," or "horny." The jaw, which is developed in nearly all of them, is referred to in the latest general work on the Mollusks (*Encyclopædia Britannica*, Art. *Mollusca*, p. 641), by Professor E. Ray Lankester in the following terms: "We find almost universally present in the *Glossophora* a pair of horny jaws (usually calcified) developed as cuticular productions upon the epidermis of the lips." The same author refers to the radula as "a chitinous band beset with minute teeth," "a horny cuticular product," and a "horny radula or lingual ribbon."

In various papers on the Mollusca, in which the dentition has been discussed, I have (and doubtless others have) called attention incidentally to the chitinous nature of the teeth of mollusks, and also to the fact that those groups, believed to be of very ancient lineage, and to have been less altered from their early status than many others, have the teeth composed of chitinous parts cemented together and to the radula with a horny cement which dissolves in boiling liquor potassæ. This is the case in the Docoglossa and Chitons. In these the base of the radula and the above mentioned cement are probably of a truly horny constitution. In the Pulmonata the radula and teeth are of a higher character, and apparently purely chitinous, though in but few of the groups has the jaw attained this constitution.

It is well known that in some of the most highly organized gastropods, such as *Conus*, the teeth are specialized, few in number, in some cases tubular, barbed and furnished with a true poison gland and duct, by which a very severe injury can be inflicted on an assailant, even a conchologist. The secretion of sulphuric acid by the genus *Dolium* is doubtless connected with its habit of boring the calcareous shells of its molluscan prey by means of its teeth and radular apparatus, and the secretion of such strength that it must form a very efficient solvent, and greatly hasten the desired result. It may also be used as a poison against a soft-bodied adversary, but this is not definitely known. The statement of Professor Lankester that the jaws of mollusks are "usually calcified," is entirely erroneous. That some of them may have a calcareous coating or reinforcement is possible, though no such case is known to me, but at any rate it must be of very exceptional occurrence.

Dr. O. Loew, well known for his chemical investigations, when connected with the Wheeler survey was kind enough to undertake, at my suggestion, some qualitative analyses of organic products, for which I furnished the materials, about 1875.

To determine the nature of the molluscan jaw a number of the beaks of cephalopods (probably *Loligo*) were examined. The black horny matter yielded very slowly to prolonged boiling in saturated liquor potassæ, but after this result a pellucid portion remained retaining the exact form of the jaw and about one-third of the total volume. This was boiled in strong acids and alkalis for a long time without yielding or being visibly affected.

Dr. Loew observed that chitine when treated with dilute sulphuric acid gives a reaction of sugar, the present substance gave no such reaction, and is therefore different from chitine and probably undescribed. It is probably closely allied to chitine but may contain a relatively larger amount of nitrogen.

Having collected a large quantity of the epidermis of the common brown mussel (*Modiola modiolus* L.) it was found to consist of purely horny matter, and dissolved with great ease in liquor potassæ. The conchioline which cements the layers of the shell is probably of a more refractory nature, but difficult to isolate without much labor except in very small quantities. If the fresh mussels be put in a box in a hot place the epidermis spontaneously scales off, and may be collected without trouble.

The horny shell of a gastropod which is distinguished by not becoming calcified (*Velutina coriacea* Pallas) was found to consist almost wholly of horny matter, with a trace of phosphate and a little carbonate of lime.

A large number of the shells of a brachiopod (*Rhynchonella psittacea* Ch.) were examined, and to our surprise yielded only a bare trace of phosphate of lime, 92 to 94 per cent of carbonate of lime, and the remainder consisted of horny matter. This raises a question as to the uniformity of the presence in other brachiopods (*Lingula*, *Discina*) of the large proportion of phosphate of lime, which has been detected in several analyses.

I have brought up this subject not so much for the value of the contribution now made to it (which is small), but rather to stimulate some of our chemical friends to work in a direction far more promising for science than some which of late have been more fashionable, and to call attention to our extreme ignorance of a great class of facts which, so to speak, lie daily before us demanding a solution.

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THE THEORY OF SEX AND SEXUAL GENESIS.

BY C. M. HOLLINGSWORTH.

(Continued from page 677, July number.)

THE view taken by Simpson seems to me altogether a just one, with regard to "the origin of those varieties of double hermaphrodites in which there is an actual coëxistence upon one or upon both sides of the body, or, in other words, in the same

segment of the sexual apparatus, of both the corresponding male and female organs. We can only refer all such instances to the laws which regulate the occasional production of local duplicities in different other organs of single bodies, and at the same time confess our present ignorance of what these laws are. We know that various individual muscles, nerves, &c, are not unfrequently found double, and that in the internal organs of the body examples of duplicity in individual viscera are occasionally, though rarely observed in the heart, tongue, trachea, œsophagus, intestinal canal, &c. In the several organs composing the reproductive apparatus, instances of similar duplicity would seem to be more common than among any other viscera." That they should thus be more common is what theory would indicate without assuming that they constitute a recurrence to an ancestral hermaphrodite form.

According to Darwin the sterility of hybrids is due mainly to an imperfect development of their reproductive organs. That there should be a greater derangement of the reproductive apparatus than of other parts, in an organism which is the product of a cross between two species, is what the theory of sex here proposed would indicate. For in the reproductive organs two redundant types have to be blended; and when a cross is effected between individuals of distinct species these two types represent parts that are functionally distributed among four distinct forms.

2. General principles pertaining to the formative conditions in the embryo also suffice to explain why it is that from a common embryonic type for the species each individual normally undergoes so pronounced a one-sided development, to ultimate in the adult characters of one or the other of the differentiated sexes, instead of developing equally and imperfectly the characters or organs of both. In considering this question these two facts should be borne in mind: 1. That where the same portion of primary tissue develops into one sexual organ in one of the sexes and into a different organ in the other sex, it is impossible for both organs to be developed in the same individual. 2. That the parts of the body of the forming embryo upon which the sexual organs are immediately dependent for the conditions of their evolution, considered as a nourishing apparatus, have not the capacity for supplying the conditions requisite to the full development of all the organs of both sexes, even if they were capable of all coëxisting in a fully developed state.

The determination to the development of the male or the female sexual gland is the essential or central fact in the whole sexual development of the individual. According to the latest views of embryologists, the ovary and the testicle in the higher animals originate from somewhat different parts of the layer of primitive generative cells which forms a thickening of a certain part of the walls of the peritoneal cavity on each side, when that cavity is formed. But since there is only a single mass of primitive cells from which either an ovary or a testicle takes its rise, we need not be particularly concerned here about whether it is the same part, or somewhat different parts, of the single mass that undergoes differential development, according as one or the other kind of glands is to be the outcome. In either case it is not difficult to understand why one kind of glands only and not both kinds is normally developed. If the conditions of development, as they immediately exist in the primitive generative cells, at the time when their development begins, are ever so little favorable to that course of development which will convert some of them into ova, they are by so much unfavorable to that course which would convert them into sperm-bearing cells; and *vice versa*. That is, the conditions that are suited to determine the development of one kind of generative cells are suited to arrest any tendency toward the development of the other kind. We are here dealing with the higher types of unisexual animals, in which there is a much more active circulation of the internal medium than in the lower animals. In the latter, germ-cells and sperm-cells are sometimes developed in near proximity to each other, but never, we may be perfectly certain, without an adequate differentiation of the conditions.

As there is a physiological, and therefore histological, difference in the stroma of the two kinds of sexual glands, analogous in kind to the difference between the two kinds of generative cells, the same statement will apply to the glands as well. Furthermore, it is probable that the same adjustment of the conditions on which cell-growth and cell-division respectively depend, which tends to initiate the development of one kind rather than the other of generative cells and sexual glands, is adapted to deflect the course of evolution of all the other accessory parts of the reproductive apparatus in the direction of the corresponding sexual type. Then the later stages of the one-sided development of

the individual in some of its sexual characters, and especially in what Hunter and Darwin have called the secondary sexual characters, is determined in great part by vital correlations between the parts thus developing and the sexual glands, established through the nervous system. This is clearly shown by the effect that is produced on the development of these parts by the removal of the sexual glands.

In monœcious and diœcious plants it is the reproductive member of the composite individual that undergoes a one-sided development. And the course of development is determined by a similar bias in the formative conditions—if not extending throughout the whole plant, at least in some manner initiated and maintained at the point from which the flower is developed. The peduncle and receptacle, one or both of which parts are common to all classes of flowers, and which are necessary to the development of the sexual organs proper, have their developmental capacities in every case adapted to their required functions; and their functions in plants in which the sexes are separate consist in giving support and transmitting nourishment to a set either of male or of female flowers, but not to sets of both. A receptacle, especially, which is required to bear organs of one sex only, will admit of being smaller and of more uniform structure than one which is required to perform the double function of bearing both stamens and pistils; and a difference of a similar kind must exist between the peduncles in the two cases. As the required structure of these parts in unisexual flowers is somewhat different for the two sexes, there is thus established not only a reduction in developmental capacity of these parts, but also a sort of structural dimorphism. And as these parts are not in themselves sexual, they tend, even when developing under conditions of an exactly medium character between those most favorable to the production of the male generative element and organs, on the one hand, and those most favorable to the production of the female parts, on the other hand, to assume the form suitable to one or the other alone.

In the higher animals that bias of the formative conditions which determines the sex is probably initiated, in most cases and under normal conditions, in the ovum at the time of its fertilization; or it may even depend on the constitution which one or the other of the combining cells has, previous to their union. But it

does not become sufficiently pronounced to produce any perceptible effect until a certain stage in the development of the embryo is reached. And the sex is no doubt subject to the controlling actions of external conditions for a time after the development begins, where the conditions of development, as they immediately affect the embryonic basis of the generative organs, can in this manner be considerably modified one way or the other.

In some of the lower animals, as will be shown farther on, the sex is subject to control at a very late stage in the life-history of the individual; and to a less extent this seems to be the case also with plants.

Causes Determining Sex.—Since germ-cells are very large and sperm-cells are small, it may at once be inferred that where they are formed in different parts of the organism, the parts in which germ-cells or their producing organs are formed must be parts in which the conditions are especially favorable to nutrition; and that the parts in which sperm-cells or their producing organs are formed, must be relatively unfavorable to nutrition and favorable to cell-division. Observation shows this to be the case; and from the causes thus indicated as determining the development of one or the other or of the two kinds of generative cells or organs, in different parts of the same organism, some of the causes may be inferred which act to determine the sex of the individual, where the sexes are separate, and the truth of the inference tested by the results of observation and experiment. There is evidence, however, that the sex of the individual may also be determined by the state of maturity at which the ovum has arrived before it is impregnated; and the true theory of sex must be capable of explaining this fact.

I will now give such evidence, of various kinds, as I have been able to obtain on the causes which determine the sex, for the purpose of showing its agreement with the theory of sex given in the earlier parts of this article. The hypothesis, it should be remembered, is, that it is a *relative* preponderance of the conditions on which cell-growth depends, or of the conditions on which cell-division depends, which causes the formation of the female or male generative organs or determines the sex of the individual. If, therefore, the conditions on which either factor of the developmental process depends remain constant, the requisite preponderance, one way or the other, may still result

from variations in the conditions of the other factor. It should be remembered further that both factors are required to be present in the developmental process in the formative or initial stage of the development of all organs, the reproductive organs included.

In the higher plants this initial part of the development is generally effected at or within a very short portion of the extremity of each axis. But whether it is confined to this part or not, it is universally the case in "perfect" flowers that the pistils occupy the central position, with the stamens disposed around them. And that the central position is the one most favorable to cell-growth, and the outer position the one most favorable to cell-division, is shown by the fact that in the pith of exogenous plants the central cells are the largest—the cells decreasing in size from the center outward. The conditions on which this difference depends are no doubt complex; but it is probably due mainly to the freer access of oxygen to the outer cells; since it has been shown that the oxygen consumed in these forming parts of plants is derived directly from the surrounding air, and is not brought to them in the sap from other parts; while the nitrogenous proximate compounds that enter into the formation of the extending axis are derived mainly from other parts, and the whole supply of the lower compounds of nitrogen necessary to the growth of the plant is taken in through the roots. The access of oxygen is required both for cell-growth and cell-division. But it is mainly to its nitrogenous constituents that protoplasm owes its plasticity or instability as to state of physical aggregation; and these constituents are also chemically less stable than the other constituents. The more active respiratory changes induced in the outer cells would, therefore, have the effect of causing them to divide more rapidly than the central cells; or of preventing them from growing to so great a size as that attained to by the central cells before undergoing division.

In monœcious plants it is the female flower, as a whole, that develops from a part in which the conditions of cell-growth predominate, and the male flower that develops from a part in which the conditions of cell-division predominate. In monœcious exogens, as hickory, walnut, &c., we find the female or pistillate flowers on a terminal peduncle, while the catkins of male or staminate flowers are produced from lateral buds of the same

branch. In *Ricinus*, the castor-oil plant, the flowers are in a short panicle, with the female flowers at the terminus of the thick main axis, and the much more numerous male flowers borne in thick bunches on small lateral branches of the main axis. In some endogens these relative positions are reversed, but only where the conditions of nutrition in the parts are also reversed. Thus in maize the staminate spikes or tassel form the terminal branches of the main stem; but they are far removed by a long and slender portion of the stem from the assimilative organs—the leaves—of the plant; while the spike of pistillate flowers that forms the ear terminates a short and thick lateral branch produced in the axil of a large leaf in the middle part of the stalk. So likewise where both male and female flowers are borne laterally on a long and tapering spike, as in *Stillingia*, the staminate flowers occupy or form the upper part, and the pistillate the lower part of the spike.

In the *Compositæ* it is generally the marginal flowers of the head that are pistillate, while the thickly-crowded flowers of the central part of the head, which are thus less favorably situated as regards nutrition, are staminate only, or in some cases perfect. The same distribution obtains also in the *Umbelliferae*. Here it is often the case that the same umbel or umbellet contains the three kinds of flowers, pistillate, perfect and staminate, clearly arranged according to the conditions of nutrition. Thus in sweet cicely (*Osmorrhiza longistylus*) and parsnip (*Pastinaca sativa*) the flowers are in compound umbels, and as regards the three kinds just mentioned, have the following arrangement: The central umbellets of the compound umbel are the smallest of all and often bear small staminate flowers only. Umbellets that are neither central nor peripheral, but intermediate in position, are also intermediate in size, and generally bear small, staminate flowers in their central parts and larger, perfect flowers in their outer parts. The outer or peripheral umbellets of the compound umbel are the largest and bear small, staminate flowers in their central parts and larger, perfect and pistillate flowers in their outer parts. Here we have a regular gradation from wholly male to wholly female flowers, with increase in the size of all the accessory parts, which difference in size must result from difference in the conditions of nutrition, or growth.

While studying the inflorescence of the wild parsnip it oc-

curred to me that since in this plant the receptacle of the umbellet is somewhat projecting in the center, and since the apex of the axis in growing plants is generally the point of most rapid growth, it might be the case that this central point of the receptacle would in some instances bear fertile flowers when parts further out and intermediate in position would not. And on more careful examination I found in many instances a single pistillate flower occupying this position, but showing this remarkable peculiarity, that it was sessile upon the apex of the receptacle; and from the considerable number of flowers in the umbellet, twenty to thirty, and the fact that all the others were carried out beyond this one, by their extended pedicels, so as to partially conceal it, I had previously overlooked it in making out the distribution of male, perfect and female flowers on the umbellet.

As has just been shown, there is a strict correlation between the size of the umbellets of a compound umbel and the sex of the flowers they bear, the smallest umbellets bearing male and the largest predominantly female flowers. In Indian turnip (*Arisæma triphyllum*) there is a similar correlation between size and sex for the whole plant, the largest plants being females, the smallest (that produce flowers) males, and many of the intermediate ones monœcious. So striking is this the case that I found that when the plants are in bloom the sex can be inferred, with a great degree of certainty, from the comparative size of the plants alone. At this time the spathe so incloses the spadix on which the flowers are borne, that it cannot be determined by direct observation whether a plant bears male or female flowers, or both, except by opening the spathe. The plants reproduce by buds from corms, and by bulbs dropped from the receptacle, and are thus found most frequently in groups, the plants in the same group varying greatly in size. The large buds from the older corms produce the largest plants, and the bulbs of the previous year the smallest; these latter, however, do not produce flower-stalks the first year.

To prove the correlation between sex and size, I made examinations at one time of 213 plants, and at another of 137 plants, while they were in bloom. An inference was first made as to the probable sex of each plant, judging from its size as compared with the others of the same group, or as compared with the average size for the locality, each plant being pronounced either

male or female, and thus no attempt being made to tell from the size which were monœcious. Then by opening the spathe the inference was found to be either right or wrong, or partly right and partly wrong, and was so recorded. Of the 213 plants seventy-four were judged, from their size, to be females, which proved on examination to be such, and ninety-six were judged to be males, which proved to be such; seven were judged to be females and ten to be males, which proved to be monœcious; thirteen, mostly of medium size, were judged to be females which proved to be males; and thirteen, mostly of medium size, were judged to be males which proved to be females. Of the 137 plants fifty-seven were rightly judged to be males, and sixty-four rightly judged to be females; so that there were only sixteen out of the whole number whose sex was wrongly inferred from the size. Thus in the great majority of cases the sex was correctly inferred from the size of the plants; and in nearly all the cases where the inference was wrong the plants were of medium size, in which case there would necessarily be much uncertainty in attempting to determine the sex in this way.

Here we have, I think, very conclusive evidence that the female sex is determined by a relative predominance of the conditions of nutrition or cell-growth over the conditions of differentiation or cell-division, as compared with the correlation of these conditions in the production of the male sex. All the external conditions of development, comprising temperature, the supply of oxygen and carbon dioxide in the air, and the supply of water and other matters in the soil, are precisely the same for all the plants of each group. The only difference is, that the larger corms contain a greater quantity than the smaller ones of elaborated and stored-up proximate compounds to be organized about a single axis of growth. And from the larger aggregations of nutritive matter female plants are developed; while from the smaller aggregations male plants are developed.

The observations or experiments of Knight furnish the most conclusive evidence we have of the nature of the external conditions which act to determine the sex in plants. He found "that several kinds of monœcious plants can be made to produce solely male or solely female flowers, by regulating the quantity of light and heat under which they are grown. If the heat be excessive, compared with the quantity of light which the plant receives,

male flowers only appear ; but if light be in excess, female flowers alone will be produced " (Carpenter, *Comp. Physiol.*, 1851, p. 979). According to Sachs' account of the conditions on which cell-growth and cell-division respectively depend, these results obtained by Knight agree with the theory of sex here proposed. "In the case of the buds of the higher plants their reservoirs of reserve material are the bulbs, tubers, rhizomes, parts of the stem, cotyledons and endosperm ; after the complete exhaustion of these, growth ceases in the dark but continues in the light, because the assimilating organs can then produce new material. This relation of growth, which is connected with cell-division, to assimilation, is especially clear in algæ of simple structure, which assimilate in the day-time under the influence of light, while cell-division proceeds exclusively, or at least chiefly, at night. The swarmspores are also formed at night, but swarm only with the access of daylight. In some Fungi, also, the splitting up of the protoplasm in the sporangium into a number of spores takes place only in the night, the spores being thrown out on the access of light. While, therefore, in the larger and more highly organized plants assimilation and the construction of new cells out of the assimilated substances is carried on in different parts but at the same time, in small transparent plants, in which the parts where these functions are effected are not surrounded by opaque envelopes, they take place at different times " (*Botany*, p. 753). The conditions on which cell-division depends are no doubt present both in light and darkness, but in the light there is a predominance of the conditions of growth.

Speaking of the segmentation of the animal ovum, Stricker says : "In the fecundated egg the spermatozoa must be regarded as the agents from which the first excitation proceeds. There can be no doubt, also, that in the act of fission a high temperature plays an important part " (*Manual of Histol.*, p. 46). This also accords with the interpretation of the results of Knight's experiments required by the theory of sex here proposed.

There is evidence of a similar kind to that now given with respect to plants, showing that in animals likewise the sex may be determined or controlled to a greater or less extent by conditions of nutrition. "According to Girou, female domestic animals bear more females when well nourished and left in repose than when much worked and on spare diet " (*Allen Thomson*,

Todd's Cyclop., art. Generation). But experiments that have been made on the larvæ of butterflies and moths furnish the most conclusive evidence that has yet been obtained of the determination of sex in animals by conditions of nutrition.

In the *AM. NATURALIST* for March, 1873, an account is given by Mrs. Mary Treat of experiments on this point, both with butterflies and moths. Larvæ that were shut up in paper boxes soon after the last molt and deprived of food, nearly all developed into males; while larvæ of the same lot that were highly fed on good food as long as they would eat, nearly all developed into females. Similar experiments have been made by Gentry with moths, and with the same results; and he adds the following facts which came under his notice in the course of his observations and experiments: 1. That males are the invariable result when the larvæ are fed on diseased or innutritious food; 2. That in the fall, when the leaves have not their usual amount of sap, males are generally produced; 3. That more males are produced late in the season than females; 4. That the sexes in early life cannot be distinguished, the change being brought about late in life by the conditions of nutrition" (Abstract in *Pop. Sci. Mon.*, April, 1874, of a paper communicated to the Phil. Acad. of Sci.). In the case of the well-fed larvæ there is a greater accumulation of nutritive material to be reorganized in the metamorphosis than there is in the case of the ill-fed larvæ; while the other conditions of development, temperature and the supply of oxygen are the same for both.

The effect which the time of the impregnation of the ovum has in determining sex has yet to be considered in its bearings on the foregoing theory of sex. Girou found that if the female flowers of dioecious plants be fertilized as soon as they are fit to receive the pollen, the seed resulting produced mainly female plants; and that if the fertilization be deferred to as late period as possible, the seeds resulting produce mainly male plants. "Starting from this idea, and supposing that the complete maturity of an ovum might be very favorable to the production of the male sex, and inversely, M. Thury, of Geneva (1863), caused cows to be impregnated, sometimes at the beginning, sometimes at the end of the rutting period. In the first case he obtained female calves; in the second male calves. The experiment was repeated by a Swiss agriculturalist, M. Cornaz, who twenty-nine times in twen-

ty-nine cases, succeeded in producing at will such or such a sex" (Letourneau, *Biology*, p. 312). Experiments on the effect of late fertilization of the eggs of birds had previously been made by Knight, "which," he states, "to have been frequently repeated," and which gave similar results. "When the female was kept without intercourse with the male up to nearly the time for laying, so that the eggs had advanced very far in their development at the time of fertilization, the proportion of males among the offspring was very large, commonly about six out of seven" (Carpenter, *op. cit.*, p. 979).

In the theoretical interpretation of these results, the important fact to be noted is, that the mature ovum, even without fertilization, generally undergoes segmentation in an imperfect manner before its death and dissolution takes place. Thus from the beginning of the period during which the ovum is capable of being impregnated to the time when segmentation begins, the protoplasmic mass of the ovum undergoes a gradual change from a more stable to a less stable state of aggregation as a mass. This change is no doubt accelerated by the access of the sperm-cell, at whatever time fertilization may take place. Still if fertilization takes place at a very early period, the interval of time which will follow before segmentation begins will be greater than it will when fertilization takes place at a later period. And there is evidence that during that interval the sperm-cell tends to become assimilated in its constitution to the germ-cell, and therefore, by hypothesis, to have its specific capacity or function of exciting cell-division to some extent weakened. Recent investigations have shown that the act of impregnation consists in the formation of a male "pronucleus," derived from the impregnating sperm-cell, which fuses with the female "pronucleus" of the germ-cell to constitute the single nucleus of the fertile ovum. And Hertwig points out, "that considerable difference may be observed in the occurrences which succeed impregnation, according to the relative period at which this takes place. When, in *Asterias*, the impregnation is effected about an hour after the egg is laid, and previously to the formation of the polar-cells, the male pronucleus appears at first to exert but little influence on the protoplasm, but after the formation of the second polar-cell the radial striæ around it become very marked, and the pronucleus rapidly grows in size. When it finally unites with the

female pronucleus it is equal in size to the latter. In the case when the impregnation is deferred for four hours, the male pronucleus never becomes so large as the female pronucleus. With reference to the effect of the time at which impregnation takes place, *Asterias* would seem to serve as a type" (Balfour, *Comp. Embryol.*, Vol. 1, p. 68).

Thus when impregnation takes place at a very early period, since the ovum in its own independent course of development has not yet reached the segmenting stage, the immediate effect of the union of the female and male elements is a modification of the male element by which it is to some extent assimilated in character to the female element. In consequence there is established in the fertilized ovum at the outset a relative preponderance of the factor of cell-growth, in its developmental tendencies; and this, by the theory, determines to the production of the female sex. But where impregnation takes place at a late period, when the ovum in its development has reached the segmenting stage, its modifying action on the male element before the union is completed is less; and in consequence there is established in the fertilized ovum at the outset a preponderance of the factor of cell-division, which the male element represents; and this, by the theory, determines to the production of the male sex.

It appears, therefore, that the theory of sex and sexual genesis that is here proposed, affords a reasonable explanation of the observed effects of the time of impregnation in determining sex. And so far as all the known causes on which the determination of sex depends are incapable of being equally well explained on any other theory, they may be taken as giving support to this theory.

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THE CONDYLRARTHRA.

BY E. D. COPE.

IN a paper on the homologies and origin of the molar teeth of the Mammalia *Educabilia*, published in March, 1874,¹ I ven-

¹ Journal of the Academy of Natural Sciences of Philadelphia. The language which I used is as follows: "I trust that I have made it sufficiently obvious that the primitive genera of this division of mammals [*Mammalia Educabilia* = *Unguiculata* and *Ungulata sensu lato*] must have been bunodonts with pentadactyl plantigrade feet."

The nearest approaches to a similar anticipation on the part of other naturalists which I have been able to find, refer to the number of toes only, and are of restricted

tured the generalization that the primitive types of the Ungulata would be discovered to be characterized by the possession of five-toed plantigrade feet, and tubercular teeth. No Perissodactyle or Artiodactyle mammal was known at that time to possess such feet, nor was any Perissodactyle known to possess tubercular teeth. Shortly after advancing the above hypothesis, I discovered the foot structure of Coryphodon, which is five-toed and plantigrade, but the teeth are not of the tubercular type. For this and allied genera I defined a new order, the Amblypoda.

In 1873¹ I described, from teeth alone, a genus under the name of *Phenacodus*, and although a good many specimens of the dentition came into my possession since that date, I was long unable to assign the genus its true position in the mammalian class. The teeth resemble those of suilline ungulates, but I had never had sufficient evidence to permit its reference to that group. Allied genera, subsequently discovered by me, were stated to have a hog-like dentition, but their position could not be determined until the structure of the feet should be ascertained.²

In his explorations in the Wasatch Eocene of Wyoming, in 1880, Mr. J. L. Wortman was fortunate enough to discover nearly entire skeletons of *Phenacodus primævus* and *P. wortmani*, which present all the characters essential to a full determination of the place of *Phenacodus* in the system. The result is, that this genus must be placed in a special group of an order which in-

application. Thus Kowalevsky remarks (Monographie der Gattung Anthracotherium, Palæontographica, XXII, p. 1452): "So we can assume a tetradactyle foot as our point of departure, although it cannot have the least effect on the result in case the original ungulate foot should have been pentadactyle; if I have set out with a tetradactyle foot it is simply because I wish to adhere, so far as possible, to facts." This was written August, 1873, but how soon thereafter it was printed I do not know. I did not meet with it until at least a year after the publication of my paper of March, 1874, cited. Secondly, Marsh, in writing on the genealogy of the horses (*American Journal of Science and Arts*, March, 1874, p. 257), says: "A still older ancestor [of the horse], possibly in the Cretaceous, doubtless had five toes on each foot, the typical number in mammals." My paper was published during the same month as the above, but I communicated the substance of the generalization in question to the Philadelphia Academy the day it was read, Nov. 18th, 1873, which was published in the Proceedings of the Society, Jan. 13, 1874 (see p. ii).

¹ Palæontological Bulletin No. 17, Oct., 1873, p. 3; also Report G. M. Wheeler, U. S. Engineers Expl. W. 100 mer., IV, p. 174, 1877. In the figure of the superior molar teeth in this work, the last molar is misplaced.

² Proceeds. Amer. Philosoph. Society, 1881, p. 495.

cludes also the Hyracoidea.¹ This order realizes fully the anticipation which I expressed in 1874, for the greater number of its species are pentadactyl and plantigrade, both anteriorly and posteriorly, and have tubercular or bunodont dentition. The order to which I have referred Phenacodus, the Taxeopoda, has been already defined in these pages.² It includes those curious mammals the *Hyracoidea* or conies, and is divisible into two sub-orders by the following characters:

- A post-glenoid process; no fibular facet of calcaneum, but an interlocking articulation between fibula and astragalus; ungual phalanges truncate.... *Hyracoidea*.
 A post-glenoid process; no fibular facets on either calcaneum or astragalus; a third trochanter of the femur; ungual phalanges acuminate..... *Condylarthra*.

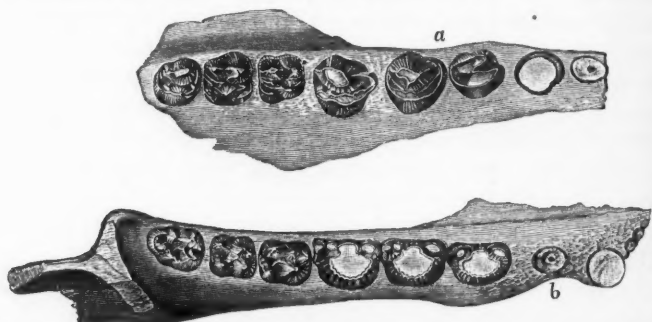


FIG. 1.—Dentition of *Peripitychus rhabdodon* Cope, two-thirds natural size. Fig. *a*, superior molars from below; *b*, inferior molars from above. From the Puerco beds of New Mexico. Original. From Vol. III, Report U. S. Geol. Survey Territories.

The astragalus in the sub-order Condylarthra is absolutely undistinguishable from that of the flesh-eating groups Creodonta and Carnivora. The humerus also presents a character of the unguiculate orders, in possessing an epicondylar foramen, which is elsewhere unknown among ungulates. The humeral condyles have the generalized character of the same type as the Amblypoda, and of the lower Perissodactyla, in lacking an intertrochlear crest.³ The Condylarthra may then be further defined as follows:⁴ *Astragalus with one uniformly convex distal articular face; humerus with epicondylar foramen.* This sub-order has as yet been

¹ AMERICAN NATURALIST, June, 1882 (May 17).

² AMERICAN NATURALIST, 1882 (May 20th) p. 523. Proceeds. American Philo-soph. Society, 1882, p. 444.

³ AMERICAN NATURALIST, April, 1882, p. 334.

⁴ AMERICAN NATURALIST, 1881, p. 1017, Nov. 29.

only found in the lowest horizons of the Eocene period, the Puerco and Wasatch, and only on the North American continent. Appropriately to this position in time, its structure indicates that it is the most primitive type of the Ungulata. A number of genera and species belong to it, and these fall into three families, which are defined as below. They conform to the definitions of the order in possessing the full mammalian number of teeth, and a third trochanter of the femur. The approximation to the Hyracoidea is greater than that of any other group of the Ungulata. That order agrees with the Condylarthra in the simple articular extremity of the astragalus, which is, however, less convex; but it has a very peculiar articulation with the anterior face of the extremity of the fibula, seen in no other group of ungulates. In the manus of the Hyracoidea the lunar bone agrees with the Condylarthra in not being divided below into two facets, as in most other ungulates, but it is peculiar in extending to the trapezoides (the intercalare), and to the unciform. In this point the Hyracoidea come nearer to the Amblypoda. In Hyrax there is also no epicondylar foramen. The three families of Condylarthra are defined as follows:

- Dentition bunodont; toes 5-5; astragalus without trochlea; neck very short; premolars very simple above and below.....*Periptychida*.
 Dentition bunodont; toes 5-5; astragalus with trochlea; neck longer; premolar teeth different from the molars above and below.....*Phenacodontida*.
 Dentition lophodont, with crescents and deep valleys; premolars partly like molars below; neck longer?.....*Meniscotheriida*.

The bunodont dentition, with very simple premolars, flat astragalus and five toes on all the feet, give the *Periptychidæ* the lowest place in the sub-order and order, as the most generalized type known. The *Meniscotheriida* have a quite specialized dentition, and until I learned its Condylarthrous character, I was at a loss to account for the presence of such perfection in so old a type. The number of the toes is yet unknown. The family appears to have had no descendants, and is a good illustration of Dr. Kowalevsky's views as to the persistence of the "adaptive" over the "non-adaptive" types of articulation. Kowalevsky observed that the types of Ungulata, which have the carpo-metacarpal and tarso-metatarsal articulations simple and not alternating, have become extinct. In those which persisted, the metapodials articulate with two bones of the carpal or tarsal series. I have discovered that the same rule has generally applied in the ungulates

to the middle carpal and tarsal articulations. The orders with the double articulation continued, while the Condylarthra, with the single articulation, have disappeared, leaving only modified descendants. The Proboscidea, which have the same simple distal articulation of the astragalus, still remain, however, to show an exception to the generalization. They have, however, an alternation in the second series of the posterior foot not present in the Taxeopoda. The relations of the genera of these three families are as follows:

PERIPTYCHIDÆ.

In Periptychus only are the posterior feet known. The carpus is yet unknown. The successional generic modifications are seen in

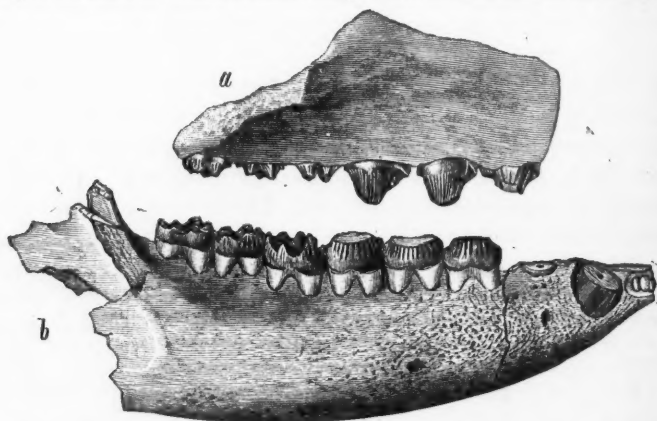


FIG. 2.—*Periptychus rhabdodon* Cope, jaws represented in fig. 1 seen in profile; two-thirds natural size. From the Puerco beds. Original.

the addition of cusps to the inner sides of the premolars of both jaws, and to the true molars of the upper jaws. In *Ectoconus* we have the largest number of dental cusps and lobes, and in *Periptychus* the next. In *Anisonchus* the inferior premolars lose their inner ledges, and the true molars their anterior internal lobes. The molars are still further reduced in *Hemithlæus*, and the premolars in *Haploconus*.

The characters of the genera are the following:

I. Three premolars.

Fourth superior premolar like molars; inferior premolars without internal ledge,

Hexodon.

II. Superior molars with intermediate tubercles, and tubercles anterior and posterior to the internal cusp; four premolars.

Superior molars with an external cingular cusp; inferior premolars without internal ledge.....*Ectoconus*.

No supplementary external cusps, inferior premolars with internal ledges, *Periptychus*.

III. Intermediate tubercles wanting; four inferior premolars, without internal lobes.

Superior molars with posterior internal cusp only, besides internal V; last two superior premolars with internal lobes.....*Anisonchus*.

Superior molars with internal V only, no other internal lobes; last two superior premolars with internal cusps.....*Hemithlaeus*.

Superior molars with posterior internal cusp only, besides apex of V; fourth superior premolar only with internal lobe.....*Haploconus*.

IV. Superior molars unknown; inferior premolar No. IV ? with two opposed crescents and a heel.

Inferior molars with one or two pairs of opposed crescents.....*Zetodon*.

All the known species of the Periptychidae are from the beds of the Puerco Eocene.

From the preceding table it is obvious that the species of this

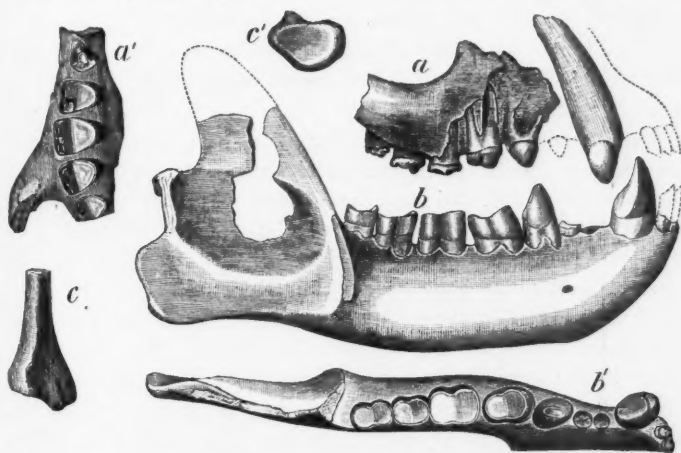


FIG. 3.—*Hexodon molestus* Cope, two-thirds natural size, from the Puerco beds of New Mexico. Fig. *a*, right maxillary bone, external view; *a'*, do. from below. Fig. *b*, right ramus mandibuli, external view; *b'*, do. from above. Fig. *c*, distal end of ? radius; *c'*, do. distal view. Original, from Vol. III, Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

family present considerable diversity in the degree of complication of their molar teeth. In all of them the premolars are more or less simple, and in *Hexodon* they are but three in number, while in the other genera there are four.

In *Hexodon* Cope the type is most developed in the direction of the dental prehension. With the shortening of the jaws comes

the loss of a premolar. The only species, *Hexodon molestus*, is known from the superior and inferior dentitions of a single individual. It differs from the *E. ditrigonus* in the short, rounded incisive region and closely-placed incisor teeth, the small posterior superior molar, and the more robust and more vertical canine teeth (Fig. 5). It is about the size of the red fox, but much more robust. It is one of the few species of the family which is armed with large canine teeth, and evidently stood preëminent in its powers of offence and defence. In the typical specimen the teeth are all worn by the mastication of hard or tough substances, so that the structure of the crowns of the true molars is not entirely known.¹

In *Ectoconus* Cope, we have the most complex structure of the molars in the family, or that the tritubercular type of superior molar is known to present. There are eight cusps on each crown, viz., one external cingular; two external; two intermediate; one internal; two (anterior and posterior) interior cingular. The typical species is the *E. ditrigonus* Cope, an animal about the size of the collared peccary. Its upper lip, and probably muzzle, are prominent, since the premaxillary bone is produced, and the small conic incisor teeth are widely spaced (Figs. 4-5). The limbs were robust, and had the general character of those of *Periptychus*. Thus the astragalus is flat, and the humeral condyles are wide, and resemble those of a carnivorous animal. Several individuals have been obtained by Mr. David Baldwin.

In the genus *Periptychus* Cope, we have the largest and most specialized forms of the family. The molars only differ from those of *Ectoconus* in the entire absence of the external cingular cusps (Figs. 1-2). The two genera agree in possessing internal cingular lobes of the superior premolars. The inferior premolars of *Periptychus* are a little more complex than in the other genera. The canine and incisor teeth are relatively small. What further characterizes the species of this genus is the extraordinary sculpture of the teeth of the entire molar series. This consists of strong grooves separated by convex ribs, which extend from the base towards and to the apex of the crown, the number be-

¹ This species is represented by a specimen which is referred by me to the *Cononyctes comma*, in the Vol. III of the Report of the U. S. Geological Survey of the Terrs., p. , and are represented in Figs. 1-5. Plate XXIII of the same. Better specimens of the *C. comma* show that the canine (or ? incisor) teeth are of very different character from those of this animal.

coming less as they ascend or descend to the latter. This sculpture is unparalleled in the class Mammalia, the nearest resemblance being found in the genus *Ichthyosaurus* among reptiles. A weak development of this sculpture is seen in the *Ectoconus ditrigonus* on the one hand, and the *Haploconus lineatus* on the other (Figs. 1-2 and 10).

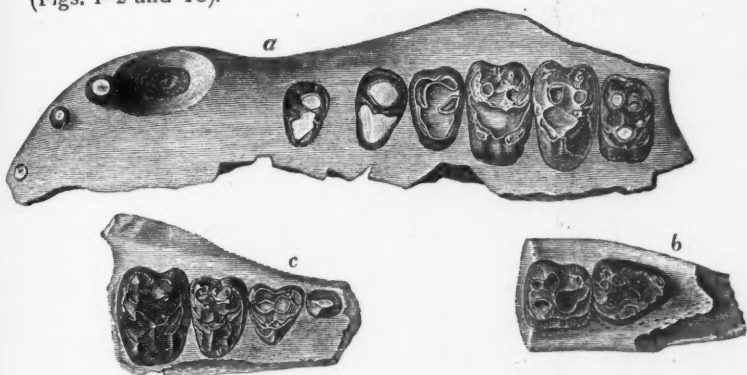


FIG. 4.—*Ectoconus ditrigonus* Cope, two-thirds nat. size; Fig. *a*, maxillary and premaxillary bones from below, retaining a good deal of the matrix. Fig. *b*, last two inferior molars worn by use. Fig. *c*, three deciduous, with first permanent molar, of a young animal. Original.

A fragmentary skull shows a postglenoid crest, and the robust posttympenic and paroccipital processes united, and leaving the meatus auditorius externus widely open below. The os petrosum is small and not inflated. The foramen ovale is not sepa-



FIG. 5.—Parts of tibia of *Ectoconus ditrigonus*; *a*, head; *b*, distal portion; *c*, astragalar facet. From individual partially represented in Fig. 3. Original; two-thirds natural size.

rated from the meatus auditorius below. There are a postglenoid foramen and a supraglenoid foramen. There is also a well-marked mastoid foramen. The mastoid bone is extensively exposed. The cranial walls are thick, and there is a strong sagittal crest. The cervical vertebræ are much shorter than in *Phenacodus*, being deeper than long, and wider than deep (Fig. 6). They are

very slightly opisthocœlous. The caudal vertebræ are quite robust, indicating a powerful tail. Dorsals not found.

The tuberosities of the humerus are small in proportion to the size of the head. The condyle is much like that of a creodont, with internal flange and external cylinder, without intertrochlear crest or ridge. The internal epicondyle is large, and is pierced above by an epitrochlear foramen (Fig. 7*a*). The olecranon is com-

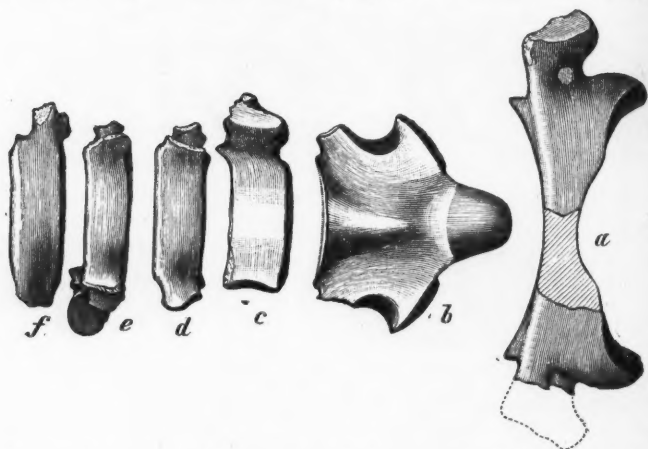


FIG. 6.—*Peripitychus rhabdodon* Cope, cervical vertebræ of individual represented in figs 7 and 8, except figs. *c d e* and *f*, which belong to another individual; nat. size. Fig. *a*, atlas; *b*, axis; *c d e f*, third to sixth cervicals; all from below. Original, from Vol. III, Report U. S. Geol. Survey Terrs.

pressed. The head of the radius has a flat articulation with the ulna. Its outline is a transverse oval, narrowed at the external extremity. The scapula has a well developed coracoid hook and the spine rises abruptly from the neck (Fig. 7*h*).

In the *P. rhabdodon* the femur is not materially larger than the humerus. The great and little trochanter are well developed, and the third trochanter is situated low down, as in *Phenacodus*, and not opposite the little trochanter as in *Creodonta* (Fig. 8 *a*).

Portions of two posterior feet preserved display five metatarsals and several phalanges. The distal carina of the former is posterior and weak. The latter are rather narrow for an ungulate, but are not elongate, and are rather depressed; the distal ones are more robust, and are rather more narrowed distally than usual in Ungulata, and the neck of a broken phalange of an external digit is nearly round in section. The third digit is longest, and the

first, shortest; it is not very short, and is quite slender. Sesamoid bones are probably present. The posterior foot is that of a plantigrade animal (Fig. 8). The astragalus is much like that of the Proboscidea in form (Fig. 8 *b*). The head is moderately long and is depressed. Its distal extremity is regularly convex from side to side. The trochlea is horizontal, and is not grooved medially, but is very slightly concave. Fibular face vertical; malleo-

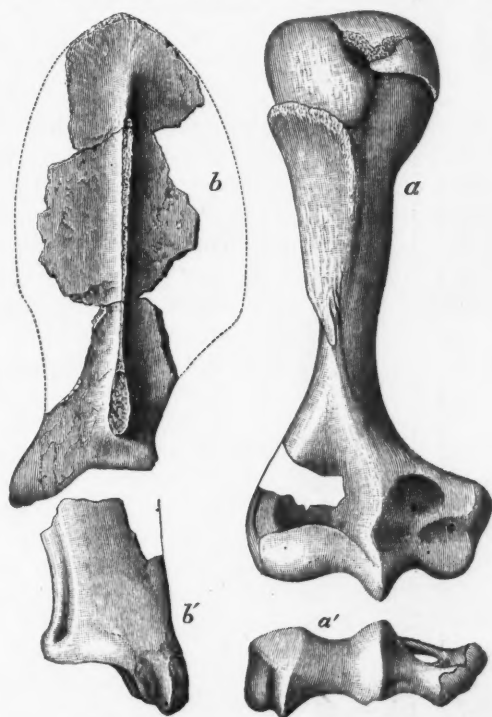


FIG. 7.—*Peripitychus rhabdodon* Cope, bones of individual represented in figs. 6 and 8, except fig. *b'*, two-thirds nat. size. Fig. *a*, right humerus, with epiphysis not united, anterior view; *a'*, do., distal view. Fig. *b*, left scapula, external side; *b'*, internal side of proximal end of another left scapula. From the Puerco beds of New Mexico. Original, from Report U. S. Geol. Survey of Terrs., Vol. III.

lar face slightly oblique, and occupied by a deep central fossa. The head is not as convex as in *Phenacodus*, but is more recurved on both sides. On the external side it is so far recurved as to be continuous (in *P. rhabdodon*) with the sustentacular facet, and a part of this face is probably in contact with the cuboid, as in

many Creodonta, but which cannot be said therefore to overlap the astragalus, as in the Amblypoda.

I have obtained a cast of the top and sides of the cerebral cavity, and the proximal portion of the olfactory chambers, from a skull of a *Peritychus* in which the teeth are preserved, and prove the species to be the *P. rhabdodon*. I describe it in detail in another place, but state here that the olfactory lobes are enormous, and the hemispheres small and very flat. The *mesencephalon* is entirely exposed. It is probably the lowest known mammalian brain (Fig. 9).

The posterior three premolars are preceded by temporary teeth in both jaws. Of these the anterior is protruded at about the same time as the first true molars, and is the last one shed, remaining until after the last true molar is fully protruded. The last milk premolar differs from the corresponding permanent one in its greater elongation. The extension is posterior, in the form of a heel with three tubercles, of which the median is very small, the crown resembling a permanent true molar, except that the anterior portion is a little more elongate and compressed. The anterior basal lobe is a mere elevation of the cingulum, as in the permanent premolar,

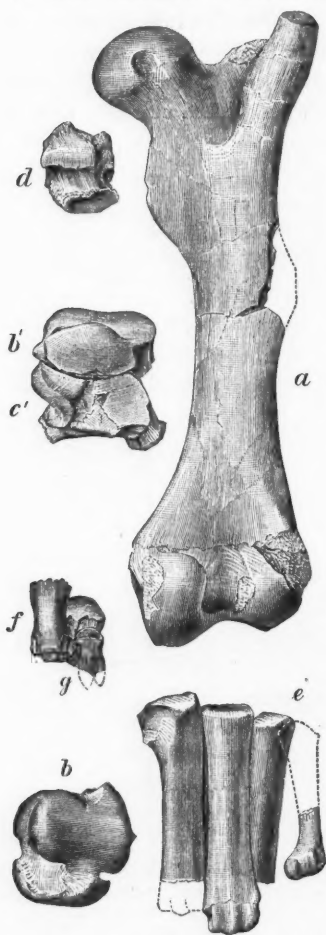


FIG. 8.—*Peritychus rhabdodon* Cope, bones, two-thirds nat. size. Fig. *a*, right femur, posterior view. Fig. *b*, left astragalus, from above; *b'*, do., distal end; *c'*, calcaneum, distal end; *d*, cuboid, from below; *e*, metatarsals, lacking M. I., from below; *f*, penultimate phalange; *g*, ungual phalange, from below. Original.

but the internal cusp is more distinct than in the latter. The

penultimate milk premolar is more like the corresponding permanent tooth, but is a little more flattened and elongate, and the heel is not tubercular. The first milk molar is a little more compressed than the corresponding permanent tooth, and the edge of the heel is not tubercular. Otherwise they are similar.

I have dwelt on the characters of this genus more fully than on those of some of the others, as it constitutes a type of striking importance in the Early Eocene fauna. Its discovery I consider to be an important event in the history of palæontological science.

But three species of the genus are known thus far, the *P. coarctatus* (Fig. 10), *P. carinidens* and *P. rhabdodon* Cope. The first two have the jaws and teeth about the size of those of the colliared peccary, while those of the last named are frequently larger than those of the white-lipped peccary. In all three species the premolars are larger than the true molars. The *Periptychus rhabdodon* must have had a peculiar appearance, and one unlike that of any known mammal. The long legs with plantigrade feet must have given it the form of a bear, but its very short neck is only paralleled by that of the elephant. While the shorter legs forbid near resemblance to that animal, and the shape of the head is very different, yet the resemblances in the figure cannot be overlooked.

It had a long tail, stout at the base. It was a smaller animal than the *Phenacodus primævus*, but the head was of nearly the same size. The dental system does not furnish any weapons of offence or defence, and none are known from any other part of the skeleton. Its large premolar teeth are compressed at the apex and are capable of inflicting a severe bite. They are well adapted for cutting flesh or even of crushing bones or other hard substances. Its food may be supposed to have included substances of this character, derived perhaps from both animal and vegetable sources. The *Periptychus rhabdodon* was the most

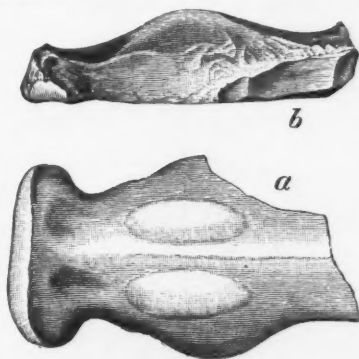


FIG. 9. Cast of superior wall of brain-case of *Periptychus rhabdodon*, nat. size. Fig. a, the base. It was a smaller animal than the *Phenacodus primævus*, but the head was of nearly the same size. The dental system does not furnish any weapons of offence or defence, and none are known from any other part of the skeleton. Its large premolar teeth are compressed at the apex and are capable of inflicting a severe bite. They are well adapted for cutting flesh or even of crushing bones or other hard substances. Its food may be supposed to have included substances of this character, derived perhaps from both animal and vegetable sources. The *Periptychus rhabdodon* was the most

abundant species of the Puerco fauna, and must have had an important place in its economy.

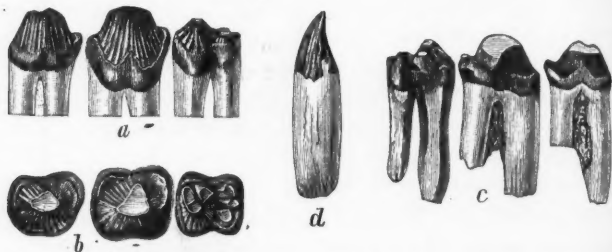


FIG. 10.—*Peripitychus coarctatus* Cope, mandibular teeth, nat. size. Fig. *a*, last two premolars and first true molar, external view; *b*, do., from above; *c*, do., inner side; *d*, canine tooth. From Puerco beds, New Mexico. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

With the genus *Hemithlæus* we enter a series of forms with simpler molar teeth and of smaller size. The intermediate tubercles of the superior molars are wanting in this genus and in *Anisonchus* and *Haploconus*, and the inferior premolars are abso-

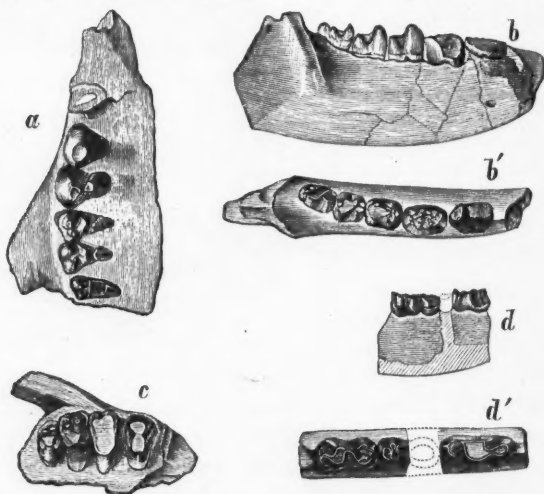


FIG. 11.—Jaws of Peripitychidæ, nat. size, except fig. *d'*. Fig. *a*, *Haploconus entoconus* Cope, maxillary teeth from below. Fig. *b*, right mandibular ramus, right side, from same skull; *b'*, do. from above. Fig. *c*, *Hemithlæus kowalevskianus*, part of right maxillary bone from below. Fig. *d*, *Zetodon gracilis* Cope, part of mandibular ramus from side. Fig. *d'*, do., twice nat size, from above. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

lutely simple in all three. *Hemithlæus* is otherwise in its superior true molars a diminutive of *Peripitychus*. The internal cusp-

like angle is flanked in front and behind by a cingular ridge, which is homologous with each accessory internal cusp of *Peripitychus*. There are two species of the genus. The type, *H. kowalevskianus*, is about the size of the Virginian opossum, and is abundant. Its premolars are robust and conical (Fig. 11 c).

In *Anisonchus* the posterior cingulum of the superior true molars supports an accessory cusp, and there is no anterior cingulum or cusp. The normal internal cusp is, as in the two allied genera, the apex of a V, whose branches terminate close to the two external cusps. The superior premolars three and four, have internal cusps whose different forms distinguish two sections of the genus. In the type, *A. sectorius* Cope (Fig. 12 a b), the form is, as in the known species of *Peripitychus* and *Ectoconus*, that of an elevated concentric cingulum; while in the *A. coniferus*, (Fig. 12 c) and *A. gillianus*, it is conical. The *A. coniferus* is the largest species, probably equaling the wolverine in size, while the *A. gillianus* Cope, is not larger than the *Bassaritis astuta*. The *A. sectorius* is an abundant species of the Puerco fauna. Its teeth are smaller than those of a placental mammal of corresponding size, and the cranium is produced posteriorly, and is narrowed posterior to the orbits. It has a well-marked sagittal crest. Its length is about that of the skull of the red fox. Two other supposed species of *Anisonchus* were not larger than squirrels.

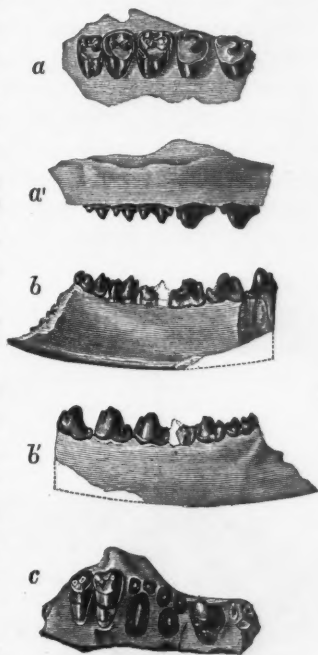


FIG. 12.—Jaws of *Peripitychidae*, nat. size. Fig. a, *Anisonchus sectorius* Cope, part of right maxillary bone with true molars and two premolars; a', same, external view. Fig. b, right ramus mandibuli of another individual of the same species, external side; b', internal side. Fig. c, *Anisonchus coniferus* Cope, right maxillary bone from below. Original, from the Puerco beds of New Mexico.¹ From Report U. S. Geol. Survey Terrs., Vol. III.

¹ This figure is made by combining portions of opposite sides of the same skull. In the original (Report U. S. Geol. Surv. Terrs., III, Pl. xxivg, Fig. 6) the artist duplicated one of the tooth bases, an error which is now corrected.

There are four species of the genus *Haploconus*. They all differ from the species of *Anisonchus* in the entire simplicity of all the superior premolars, excepting the fourth. The internal cusp of the latter tooth presents the same variations as that of the species of *Anisonchus*. In the type, *H. lineatus*, the cusp is an elevated cingulum, and in *H. entoconus* (Fig. 11 *a b*) it is conical. The latter is the largest species of the genus; the former comes next in size, and is the most abundant. In both, the premolars are larger than the true molars, a character especially conspicuous in the *H. lineatus* (Fig. 13 *a*). This species is abundant, though the *H. entoconus* is not rare in the lower Puerco beds. In some of the species of this genus the posterior internal accessory cusp is so produced as to become the apex of the triangular superior molar. In the *H. xiphodon* Cope, the inferior premolars are elongate and much compressed, so as to be quite sectorial in function (Fig. 13 *c*).

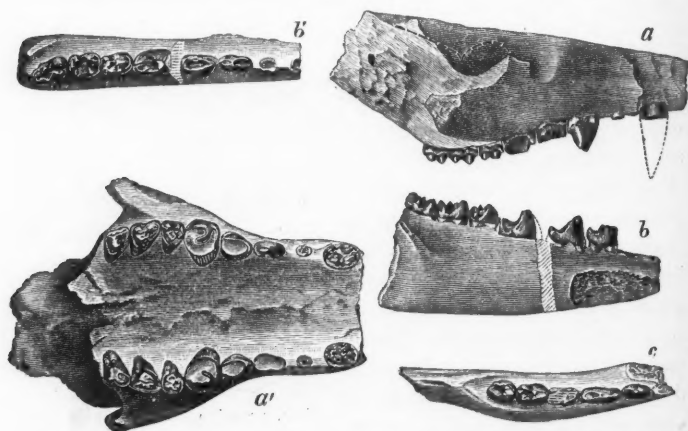


FIG. 13.—Species of *Haploconus*, natural size, from the Puerco beds of New Mexico. Fig. *a*, *Haploconus lineatus*, anterior part of cranium, right side; *a'*, do., from below. Fig. *b*, left mandibular ramus of same species, different individual, inner side; *b'*, do., from above. Fig. *c*, *Haploconus xiphodon*, part of right ramus mandibuli, from above. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden in charge, Vol. III.

In the genus *Zetodon* we have a distinct form of inferior molar. Each crown is theoretically composed of four crescents in pairs, in each of which the concave faces are presented *towards each other*, an arrangement unknown in any other genus of mammals.

In the fourth premolar there are two opposite crescents in front, like those of the true molars, but the posterior part of the crown is not double. The only species, *Z. gracilis* Cope, is a small animal with jaws not larger than those of a hedge-hog (*Erinaceus europæus*, Fig. 11 d).¹

All the specimens of the Periplychidæ now known, were discovered by my assistant, Mr. David Baldwin, in New Mexico. Not only these, but the eighty species of Vertebrata now known from the Puerco epoch, are the results of the untiring, and sometimes dangerous explorations of this gentleman. Few palæontological collectors can show such a record.

(To be continued.)

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EDITORS' TABLE.

EDITORS A. S. PACKARD, JR., AND E. D. COPE.

— In one of its late issues, our esteemed cotemporary, *Science*, advocated editorially the creation of an International Scientific Association, which should have its congresses, at intervals to be determined on, in the different countries of the civilized world.

Various objections may be urged against the organization of new scientific bodies, most of which are derivable from a consideration of the imperfections of those which exist. Should such an association be composed solely of persons distinguished for actual work done in pure science? or should experts in applied science be admitted to membership? or thirdly, should any person interested in science be eligible for membership? On the determination of its founders in respect to these fundamental points, the usefulness of such a body would depend. On its probable usefulness would depend the advocacy of many of the friends of science.

The utility of the meetings of scientific workers when properly managed, is generally conceded. The occasional emergence of the student from his studio to mingle with others engaged in kindred pursuits, has a stimulating and encouraging effect. It

¹ Correction.—In the article on the Tertiary Marsupialia in the last (July) number of the NATURALIST, I remark (p. 687): "The extinct marsupials belong to three types as distinguished by their superior molar teeth. These are trituberculate, quadrituberculate or multituberculate." As some of the extinct marsupials are Macropodidæ, the above language should be changed so as to read, trituberculate, quadrituberculate, multituberculate, or derivative forms.

serves especially to keep alive an *esprit du corps*, which may counteract the effect of the isolation in which the worker in science finds himself in many communities. The associations also impress the public with the active existence of the scientific workers, in a prompt and efficient manner. And more may be learned by a few hours of personal intercourse between specialists, than in many weeks or months of exploration among books. If the associations are under proper management, they have the especial advantage of impressing the dignity and importance of the objects of scientific labor on all concerned. These are the advantages of such bodies.

The disadvantages of course would flow from bad management. If the amateur or dilettante element enter largely into such an association, its life will be feeble and its influence small. The time necessarily involved in its material support and conduct will be largely wasted. So will be the time occupied in attending its sessions. Such a body would become the prey of the advertisers of themselves or of their wares, and a field for the exercise of political manipulation.

An international association of the actual workers in pure science would have our support, should it prove to be practicable. And here we make a suggestion. An International Association of Geologists already exists. It originated in a movement in Philadelphia at the time of the Centennial Exposition. Its first meeting was held in Paris at the time of the French Exposition of 1878. Its second meeting was held at Bologna in 1881; and the third meeting will be held in Berlin on the 25th of September of the present year. The congress has been so far a success. Why should not this body be developed into the International Association of Science? It often is easier to expand than to build anew. It is less expensive. The members of the Geological Congress cannot be spared from the more comprehensive association, and they cannot attend the meetings of two such bodies.—C.

— The tercentenary celebration of the University of Edinburgh was notable not only from the inherent interest of the occasion, drawing together some of the most distinguished university men of Great Britain and the continent, but from the scientific flavor pervading this popular and national occasion. According to a correspondent of the *Nation*, "so far from theol-

ogy or even letters holding the foremost place at the celebration, it was chiefly natural science that was glorified, and the scientific men who bore away the palm of applause and curiosity."

May this occasion be prophetic of the period, not now we hope far distant, when the physical and natural sciences will have an equality in rank and importance with letters and elementary mathematics in all universities and colleges; when entrance examinations to these institutions will demand as much preliminary training in the observational sciences as in language or mathematics. Then will dawn the era of a truly liberal education; an age of many-sidedness in contrast with the onesided "liberal" education of commencement dinner speeches.

—:O:—

RECENT LITERATURE.

THE DUKE OF ARGYLL'S UNITY OF NATURE.¹—This book is in effect a treatise on natural theology; at any rate it will by many perhaps be so regarded and used. It is written in a catholic spirit and from a comprehensive point of view. The style is readable, graceful, and the discussions are never dull and seldom prolix. The Duke of Argyll is somewhat of a naturalist, and a good deal of a theologian, as well as a man of affairs. He apparently accepts the doctrine of evolution, and pays profound respect to the genius and powers of observation of Darwin; and apparently uses his theory wherever it suits his purpose. As a treatise on natural theology it may then be regarded as the most modern work of the sort.

Beginning with a statement of what constitutes the unity of nature, the Duke of Argyll assumes that the monotheistic idea preceded the idea of the unity of nature, and that man's first beliefs were derived from authority. It will be seen at the outset that the plan and treatment of the book is essentially dogmatic and *a priori*, *i. e.*, theological rather than inductive or scientific.

After illustrating the idea of the unity of nature from the point of view of physics, astronomy and chemistry as well as biology, the following topics are discussed: Man's place in the unity of nature; animal instinct in its relation to the mind of man; the limits and truthfulness of human knowledge; the elementary constitution of matter in relation to the inorganic and organic; man as the representative of the supernatural; the moral character of man; the degradation of man; the nature and origin of religion, and the corruptions of religion.

The work on the whole may be regarded as an attempt to put new wine into old bottles. We should prefer to begin with the

¹ *The Unity of Nature*. By the DUKE OF ARGYLL. G. P. Putnam's Sons, New York, 1884. 8vo, pp. 571.

simpler facts of creation, to employ the inductive, scientific method; give more stress to the teleological argument, and to illustrate the unfolding or evolution of life-forms and of mental and intellectual traits, and thus arrive, by a cumulative argument, at the idea and proof of the existence of an Author of creation. This line of argument would have great force with those who tend to materialistic or agnostic views.

A curious survival of an early though still widespread view, is the doctrine of the fall of man, that man did not rise from a savage to a civilized state; whereas the results of archæology and ethnology all strongly point to the conclusion that primitive man was what is usually termed a savage, and that language, the arts of life, and civilization had a natural growth. The Duke of Argyll has the hardihood to write of "the inconceivability of a first man as savage," though no physical facts are brought forward to bear out the notion. It is the dogmatism, the *a priori*, metaphysical method and curious mixture of new facts and theories with unscientific unsupported views which render this book as a treatise on natural theology a sort of half-way house, a modern structure pieced-out with mediæval bricks and mortar. A work of this sort will have to be done over again, with modern tools and materials, if it is to be adapted to the modern mind.

THE STANDARD NATURAL HISTORY.—Parts XII, XIII and XIV of this excellent work are occupied with an account of the ungulates, which has been prepared by Professor R. Ramsay Wright. It is one of the most valuable of the chapters in the work, has been prepared with care, is well written, and is authoritative as well as fresh in its mode of treatment. For the first time, so far as we are aware, we have in English some account of the new species of horse discovered by Przevalsky in Central Asia, and described as *Equus przewalskii* by Powakof, and its relations to the allied forms clearly indicated. Professor Wright says: "That *Equus przewalskii* may have been indigenous further to the west, not only on the Jaik or Ural of the present day, but even beyond, in Northeastern Europe, is highly probable, judging from the history of its companions in the steppes of Central Asia." He also quotes Powakof at length, who suggests that the primeval horse of the stone age in Central and Eastern Asia, "may have presented some such relationship to our *Equus przewalskii* as exists between the Kiang, Djiggetai and Kulan." After descending with man from the more favored hilly region, they may have together entered the plains, where human activity appears to have been of a more recent date, probably in the bronze and iron period. But however this may have been, *Equus przewalskii* is the sole wild species having close affinity with the horse (our domesticated *Equus caballus*)."

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PLATE XXII.



The American Bison.

excellent, though brief. The illustrations of the peccary and



American bison are examples of the wood cuts, a large proportion of which are borrowed from Brehm's *Thierleben*.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.¹

AFRICA.—*The Somali*.—The country of the Somali appears to be impenetrable at the present time to Europeans. M. Georges Revoil, who recently attempted to traverse the country, would have met with the same fate that overtook Kinzelbach at Guelidi twenty years ago, had he not escaped by night. He had a narrow escape. The escort lent him by Omar Yousef, king of Guelidi, had orders to kill him, and the watchfulness of a few friends alone saved him from becoming, like Sacconi, the victim of a treacherous night attack.

The Cameroons.—The Polish explorer Rogozinski, leaving his ship at Santa Isabella (Fernando Po) proceeded by canoe to the Bay of Ambas, at the foot of the Cameroons mountains, and fixed his station at Mundaleh or Mundoleh, one of the islands in this bay. This island was ceded to him by treaty. He then set himself to explore the great Cameroons river, the embouchure of which is a vast estuary into which empty themselves three other rivers, the Mungo, from the Cameroons mountains to the north, the Lungasi and the Qua-qua or Edee. He was not able to proceed more than sixty-five leagues up the Cameroons, on account of the opposition of the people and of the king of the country. Meanwhile his ship was destroyed by a hurricane, yet he continued to work upon the establishment of his station, and on August 13, 1883, started with M. C. Tomezek on an exploration of the Mungo. The travelers succeeded in discovering the upper course of this river and its cataracts, found two lakes in the watershed between the Cameroons and the Calabar, and explored the upper course and sources of the Rio del Rey. On Nov. 27 they marched, accompanied by 600 men of the tribe of the Beferenganyas, to the frontiers of that tribe, but their hope to penetrate into the interior was destroyed by the defeat of the Beferenganyas by the hostile Mokonyés. On his return to Mendoleh, M. de Rogozinski traversed the Cameroons mountains throughout their entire length. It is his intention, after recruiting, to again attempt to penetrate the interior and reach Lake Liba.

Socotra.—Dr. Emil Riebeck, with Dr. Schweinfurth and others, visited Socotra in 1881, and the results of their observations have lately appeared in pamphlets upon the people and the flora of the island, by Dr. Schweinfurth. The animals and plants have strong affinities with those of the African and Arabian coasts opposite, but there are also Mediterranean types, as well as forms related to those found on the Abyssinian highlands, South Africa and West Tropical Africa. The Madagascan affinities insisted on by

¹ This department is edited by W. N. LOCKINGTON, Philadelphia.

Mr. Godwin Austen, of the British expedition, are doubted by the Germans.

The true Socotrans of the interior of the island are by Dr. Schweinfurth believed to resemble most closely the Mahra and Qara tribes of middle South Arabia. This is borne out by the resemblance of their language to that of the Mahrás. The people are ten to twelve thousand in number, and there seem to be two races, one dark with curly hair, the other lighter with straight hair.

THE ARCTIC.—Mr. Edward Whymper states that the height of the glacier-clad interior of Greenland in lat. 70° – 71° considerably exceeds 10,000 feet. He describes it as presenting, everywhere between $68^{\circ} 30'$ and $71^{\circ} 15'$, a high level ridge, so absolutely covered by snow and ice that not a crag breaks the line. Many of the highest mountains are strewn with drifted rocks to their summits.

Dr. Thoroddsen has recently explored the peninsula of Reykjanæs, Iceland. This little-known region is almost covered with lava, and perforated in every place with craters, sulphur vents, and hot springs. The interior is formed of a large plateau with hillocks, crossed by valleys, and totally devoid of vegetation and water. Dr. Thoroddsen has discovered thirty volcanoes, large and small. Only two, Thurrárhraun and Trölladyngia, were previously known. Five of these volcanoes at least have been in eruption in historical times. The eastern and southern part of the peninsula is chiefly built of palagonite breccia, while the northern is covered with doleritic pre-glacial lava-streams, which were previously supposed to exist only at Ok and near Reykjavik. In some places new lava overlays these materials. Dr. Thoroddsen examined also the geological conditions of Bordarfjardarsýsla and its hot springs, traveled across the great interior table-land of Iceland to the Langjökul, and explored the volcano Skjaldbreiður, which is 3400 feet high, and has a crater 900 feet across.

The eastern coast of Greenland has by Baron Nordenskjöld been proved to be separated by a comparatively narrow and shallow cold current from a warm current coming from the south.

Lieutenant Holm, chief of the Danish Expedition to the east coast of Greenland, states that the natives of that coast, who come to the western coast to exchange their bear, fox and seal skins for European merchandise, cannot support the climate of that coast, but fall victims to disease, especially small-pox. These eastern Greenlanders are more like the Eskimo than those of the western coast. The men are tall and bearded, sometimes even good looking, and the women better looking than their western compatriots. They live a nomadic life, wandering in summer in search of hunting and fishing grounds, while in winter several

families unite to live in huts made of earth covered with turf and stones. Lieutenant Holm penetrated to 61° W. lat., and found the coast indented by deep fiords which are not marked on the maps. South of 61° N. lat., and even for many miles to the northward, the interior ice cannot be seen. The interior of the country, as viewed from a mountain 3000 feet high, consists of mountains rising 7000 feet and more above the sea.

THE PACIFIC ISLANDS.—*Mr. Forbes' Visit to Timor Laut.*—The trip of Mr. Forbes and his wife to Timor Laut has, to some extent, cleared the character of the natives of those little-known islands. Three months were passed at the village of Ritabel in the Island of Larat without any but friendly relations. The natives sold their visitors a site for a house, and did their very best to teach them their language. To this end the young women and men would bring objects and make them repeat the names. The houses seem all roof and floor. They are raised four or five feet from the ground, and entered through the floor by a trap door which is shut down at night. The *dodokan*, or seat of honor, with ornamented supports and a high carved back, is placed in front of the door. On the top of the back is an image, with a platter by its side. On this the natives place a little food every time they eat. When they drink they dip their finger and thumb in the fluid and flick a few drops upward with some words of invocation. All around the sides of the house a space for sleeping is raised some nine to twelve inches above the floor. The inmates rest their heads on pieces of squared bamboo with rounded edges, like the Chinese pillow, and recline on small, neatly made bamboo mats. In one gable is the *faan* or fire-place, and opposite is a trellis-work platform on which is placed the cranium of the father of the house. Indian corn and other food, with sundry articles, are stored on little platforms stretching between the rafters, and the scanty clothing of the inmates is suspended from the roof by elegantly designed and carved wooden devices. The elaborate carving lavished on every article is surprising. The travelers ran a narrow escape of death for want of proper food, for the natives would give nothing away, were suspicious of gold, because they had been cheated with false gold, and only cared to purchase articles of which they felt the immediate necessity.

The name Timor Laut is Malay. The natives have no name for the group. The principal island, extending from 7° to 8° south latitude, west of 131° W. long., is Yamdena, north-east of this is Larat, and south-west of it Selaru. No land on Larat or Yamdena rises over about 200 feet, and the whole of the latter island, and probably of most of the others, as far as was visited, is coral, which forms cliffs often sixty or eighty feet high around the coast. About Egeron strait, between Selaru and Yamdena, these

cliffs are said to reach 400 feet. The soil is very thin. North and north-west of the larger island are a number of others, among them the peak of Laibobar, probably an extinct or dormant crater, and some 2000 feet high. There are no rivers or streams, the so-called fresh-water is skimmed-off holes in the coral, and is brackish. The natives are constantly at war. In Larut, Ritabel and Waitidal are at feud with Kaleobar and Lamdesar. The village of Ritabel is on the foreshore against a cliff. The houses are in irregular streets, with their gables to the sea, so that the prahus can be run up under them, though in some cases separate sheds are built for the boats. A high, strong palisade, removable by day on the shore side, surrounds the village. The ground outside is everywhere, except upon a narrow path, beset with sharp bamboo spikes. A visit to Waitidal brought Mr. Forbes into trouble. Jealous of his residence in Ritabel the Waitidal people endeavored to detain him as a prisoner, but he escaped by taking advantage of their love of raw palm-spirit. Waitidal is on the summit of a bluff, and the gateway is reached by a stair of dark red wood, the sides elaborately carved with alligators and lizards. The men vary greatly in stature, some are short and thickset, scarcely over five feet, while others reach five feet eleven inches, or even six feet or more, and are splendid looking fellows with magnificent muscles and perfect frames. The natives wear their hair combed out, and adorned with black, red and white calico bands. They dye it a rich golden color, with cocoanut, ash and lime. Very few show true frizzled hair. The women also vary from under five feet to almost six, are finely proportioned and graceful in every motion. The girls are often even handsome. In color the natives are a rich chocolate brown; the forehead retreats slightly, the brows are low, and the eyes are small and narrow. There are two forms of nose, in one of which the tip is upturned and both nostrils visible in front, while in the other the tip is depressed and the *alæ nasi* much inflated. There is a tendency, in many cases, for the upper jaw and teeth to overhang the lower. The ears are small, but much disfigured by elaborate earrings.

The climate is highly insalubrious, and the travelers suffered severely from fever.

Some sixty species of birds were brought from the Timor Laut or Tenimber islands by Mr. Forbes. Among these Mr. Sclater finds twenty-three that have not been found out of that area, and twenty of these are new. The birds as a whole are Papuan rather than Australian. Many are also found in Aru, but one or two occur also in Timor and even in India.

The insects of Timor Laut show a great preponderance of Timor forms over those of Aru or New Guinea, probably because they are more influenced than the birds by the prevailing winds. Several new lepidoptera were found.

The plants of Timor Laut are mostly *coral island* plants, but with some peculiar forms, one species belonging to the flora of New Hebrides, and one to that of Australia. Cocoanuts, ferns, clerodendra, solanums and malvaceous shrubs occur. The low shrubby forest is, in some places, almost impenetrable from its spiny character. The largest trees are fig trees (*Urostigma*) and *stereulias*. The latter is near to the fire-tree of Australia, and their crowns of bright scarlet flowers, thrown out in advance of the foliage, are very conspicuous. Leguminous trees and myrtles abound; there is a *pandanus*, and a few palms. A green carpet of *Commelyna* hides the rough coral. *Artocarpus incisa* is not uncommon. There are no *casuarinas*, *phyllode-bearing acacias*, *eucalypti* or *melanolenas*.

Lieutenant Beresford has ascended the volcano of Ambrym, in the New Hebrides. The active crater is about a quarter of a mile wide, but there is a large extinct one three or four miles across, and other smaller extinct ones. All the hills seem to be mere cinder heaps.

GEOLOGY AND PALÆONTOLOGY.

THE CHORISTODERA.—We are now indebted to Dr. Lemoine, of Reims, for a general elucidation of the European form which corresponds with the American genus *Champsosaurus*,¹ and which has not yet been shown to be distinct from it. The osteology is described in a pamphlet published by the author at Reims under the title, "Etude sur les Caractères Génériques du Simædosauire, reptile nouveau de la faune Cernaysieme, etc., 1884." The results obtained by Dr. Lemoine are very interesting, and quite anticipate the information which it was hoped that American material might furnish. The results of my own studies on *Champsosaurus* were thus expressed in 1876.² "As a summary of the preceding I propose to refer the genus *Champsosaurus* to the order *Rhynchocephalia* provisionally. It differs very much from *Sphenodon* in the non-coössification of the sacral vertebræ and non-union of the neural arches of the vertebræ with their centra, and the absence of the chordal perforations of the latter. * * On these grounds it may constitute a distinct suborder under the name of *Choristodera*," Dr. Lemoine states that M. Dollo has indicated to him that the form presents affinities to *Sphenodon* (= *Hatteria*),³ and Dr. Lemoine himself finds resemblances in the vertebræ and teeth to that genus. The results of his researches in other directions, however, compel a different conclusion as to the true position of this suborder.

¹ Cope. Proceedings Philadelphia Academy, Dec., 1876. *Simædosaurus* Gervais, *Journal de Zoologie*, Feb., 1877.

² Proceedings Phila. Academy, p. 350.

³ Etude, p. 37.

In the first place, Lemoine shows that the genus is streptostylicate, and that the quadrate bone has much the character of that of the Pythonomorpha. It can, therefore, only be properly compared with that order, the Lacertilia and the Ophidia. The single rib-heads and the separate odontoid bone are entirely confirmatory of this affinity. There is therefore no longer any propriety in comparing it with the Rhynchocephalia or the Crocodilia. Is it a Lacertilian or a Pythonomorph, or to what division of the streptostylicates is it to be referred?

Dr. Lemoine has discovered what he regards as a distinct cranial segment ("vertebra") interposed between the occipital and parietal segments in this genus. This is very remarkable, and constitutes a strong mark of distinction between the Choristodera and Lacertilia. It will depend on future investigations to show whether such difference exists between this order and the Pythonomorpha and Ophidia. In this question everything depends on the interpretation of the pieces. The new segment consists, according to Lemoine, of an "anterior basioccipital" as axis, which is surmounted by the opisthotic, and this by the epiotic on each side. It is closed above by the supraoccipital (*Etude*, p. 14). The segment in front of this Lemoine identifies with the sphenoidal. Its axis, then, becomes the sphenoid bone, and its lateral pieces the proötics. According to Lemoine's figure six, the latter elements meet on the middle line above, and the parietal lies above them. A notch on the lower part of the front margin of the so-called proötic is identified with the foramen of the trigeminal nerve.

Without access to similar specimens it is impossible to know whether any of the axial pieces of this skull is a parasphenoid or not. In any case we shall learn something by comparison with the snake and pythonomorph skull. Each of these, as is well known, presents a decurvature in front of the proötic bone, which reaches to the sphenoid or presphenoid. The foramen of the fifth nerve is posterior to this, in the position of the one assigned by Lemoine to the eighth nerve. If now we identify Lemoine's proötic with the lateral or "alisphenoid" plate of the parietal segment of the above orders, we have the normal number of cranial segments remaining. The "opisthotic" (fig. 4) becomes proötic, and the "anterior basioccipital" becomes sphenoid. This is the more probable identification, because in the streptostylicate reptiles, the opisthotic is largely or entirely excluded from the cranial walls, and becomes part of the suspensorium of the quadrate. Moreover, many of the Lacertilia possess ossifications of the anterior membranous wall of the brain-case in front of the true proötic, which nearly meet on the middle line above, in the manner of the anterior elements described by Lemoine.

To the resemblance which this structure bears to that of the Ophidia must be added the absence of true roots of the teeth.

These points, together with the natatory limbs, indicate that the position of this group is with the order or suborder Pythonomorpha. The characters which distinguish it are, the distinctness of the anterior pieces, which may be called, for the present, alisphenoids; the amphiplatyan vertebræ, and the presence of condyles of the phalanges. The Choristodera will be distinguished by these characters wherever placed.

The dentition is remarkably like that of the bony gar, *Lepidosteus*, and Dr. Lemoine has enabled me to identify specimens as to whose place I have hitherto been greatly puzzled.—*E. D. Cope*.

THE FORMATION OF STATUARY MARBLE.—From numerous experiments conducted separately by MM. Berthelot, Bonssingault and Dieulafait, it appears that the chalk must be very rich in manganese. Fifty-six examples from the chalk of the Paris basin, operated upon last year, gave this result without exception, and twenty examples from England and various parts of Europe, have since then yielded the same results in the hands of M. Dieulafait. The presence of manganese was evident in half a gramme of chalk. Manganese is also found in a state of complete diffusion in the marbles of Carrara, Paros and the Pyrenees. Important geological consequences result from the discovery. Even as low as the lower gneiss, limestones exist, often arranged in concentric layers like the coats of an onion, whence they are called "cipolin" marbles. In some places these marbles form considerable masses and can be exploited, but more frequently occur in isolated lenticular masses, often ending in thin streaks which become lost in the enclosing rock. This arrangement proves that the cipolins are contemporaneous with the rocks enclosing them. The examination of samples of the rocks from almost every part of Europe and from the United States, has shown manganese to be present in such quantities that it is perceptible in half a gramme, or, in at least half the cases, in a few centigrammes of the rock.

Guided by the idea, derived from chemistry, that when carbonate of lime is in presence of a salt of iron and a salt of manganese, the iron will be precipitated almost pure, while the greater part of the manganese will remain in solution, M. Dieulafait thus explains the geological process. The magma of gneiss was composed principally of silicate of lime and alumina, with a considerable quantity of lime and a sensible proportion of iron and manganese. Water circulating throughout this mass would dissolve the lime and manganese and leave the iron, and the carbonate of lime, thus freed from the greater portion of the iron would be of that clear white suitable for statuary marble, and would be deposited in concentric layers in the midst of the highly colored gneissic rocks.

THE GENUS *PLEURACANTHUS*.—In the AMERICAN NATURALIST for April, 1884, p. 413, I gave a brief abstract of the characters of the skull of *Didymodus*, and proposed to regard it as the type of a new order to be called the Ichthyotomi. I now give a plate of the skull of *D. compressus* and *D. platypterus*, sp. nov.—E. D. Cope.

EXPLANATION OF PLATE XXIII.

(I owe this plate to the American Philosophical Society, who will publish it in the forthcoming number of their Proceedings.)

All the figures two-thirds natural size except fig. 5, which is one-half larger than nature.

FIG. 1.—Skull from above, right frontal bone displaced and its anterior extremity broken off. Posterior apex broken from right frontal cartilage bone. *a*, frontal or supraorbital bone, that of the right side displaced; *b*, anterior nostril; *c*, postfrontal facet for palatopterygoid; *d*, frontal fissure.

FIG. 2.—Posterior part of skull of another individual, from above; *a*, occipital bone; *b*, parietal; *c*, cornua of frontal bone.

FIG. 3.—Anterior view of fig. 2, displaying section of brain case; *a*, frontal or parietal cartilage bone; *b*, sphenoid; *c*, brain cavity; *d*, frontoparietal fontanelle; *e*, hyomandibular condyle (? pterotic bone).

FIG. 4.—Anterior part of skull, from below, of a third individual, displaying orbits and postorbital processes.

FIG. 5.—Tooth of *Didymodus compressus* Newb., natural size, posterior view.

FIG. 6.—Palatopterygoid and mandibular arches of a fourth individual, from right side, with *hm*, hyomandibular.

FIG. 7.—Superior tooth of external row, without apices of two of the cusps; from the palatine bone of the specimen represented in fig. 5; one-half larger than nature, anterior view.

FIG. 8.—Tooth of *Didymodus platypternus* Cope, nat. size, from above posteriorly.

FIG. 9.—Tooth of a second specimen of *Didymodus platypternus*, from below.

ORIGIN OF CORAL REEFS.—Professor A. Geikie sums up a considerable amount of evidence which has accumulated since Charles Darwin's theory on this subject was put forth, tending to show that the theory (essentially that of growth of coral in connection with subsidence of the sea bottom) is by no means universally applicable. Semper and Rein supposed that in some cases raised masses of sand or deep-water corals are formed which afford resting places for surface-growing corals; the form of the islands, Semper held, is caused by the death of the inner parts of the colonies of corals, and by the action of the tides. Mr. J. Murray, from observations made on the *Challenger*, considers that volcanic cones, such as form most oceanic islands, tend to be reduced to submerged banks by the action of the waves; also, that the raising of the sea-bottom to such a height as to favor the growth of corals, is due to the unusually rapid accumulation near the shore of calcareous débris derived from dead pelagic organisms. These are so abundant as probably to represent upwards of sixteen tons of carbonate of lime in suspension in the uppermost one hundred fathoms of every square mile of the ocean. In the deepest water these appear to be dissolved before reaching the bottom, but they accumulate on shallow bottoms, and thus furnish

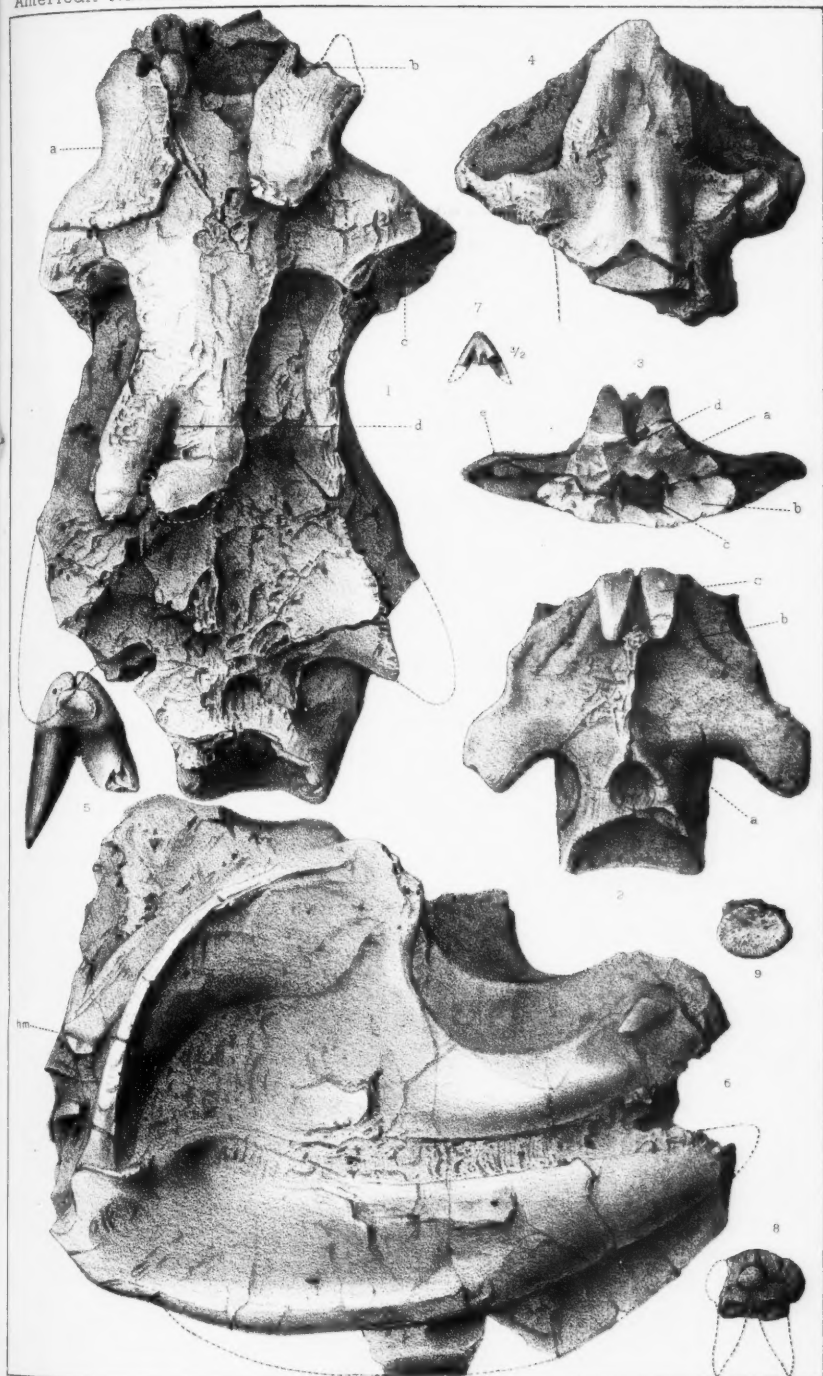
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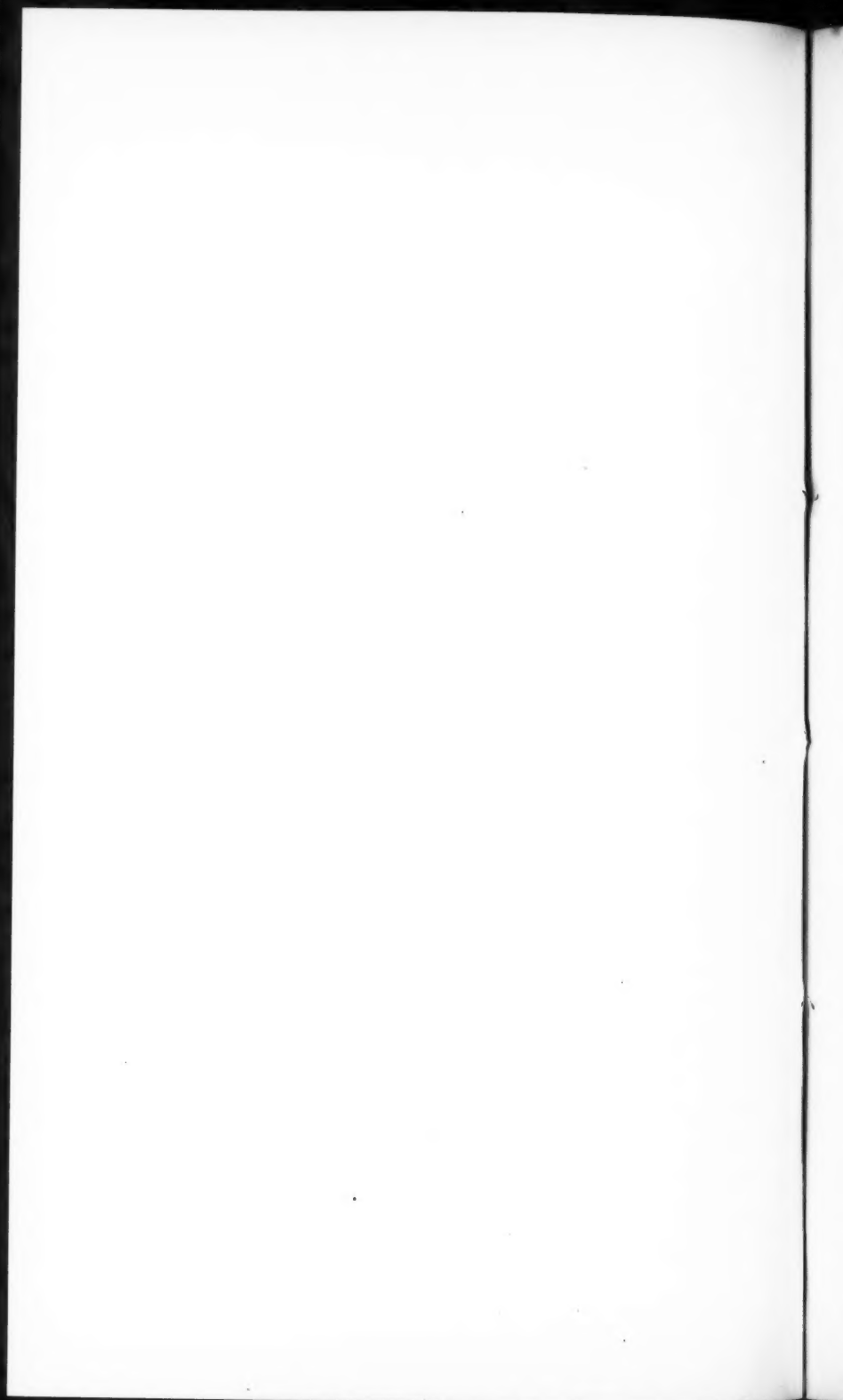
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SKULL OF DIDYMODUS.



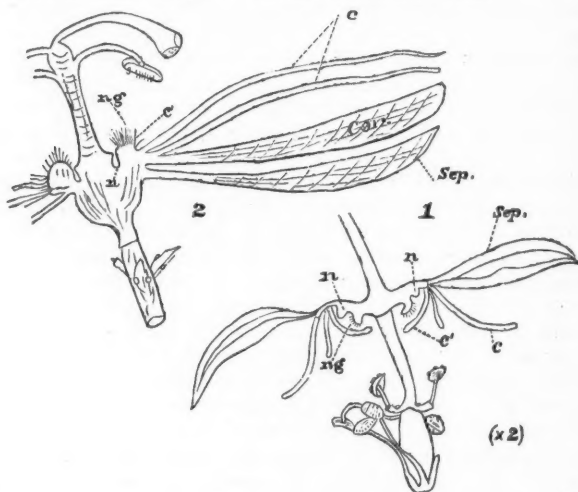
foothold for sponges, various cœlenterates, &c., which in return die and bring up the bottom to the level of reef coral growth. This, taking place on a submerged bank, would produce the atoll-form of island, which would tend to widen by death inside, and by the consequent solution of the dead coral by the carbonic acid of the sea-water. Special cases, such as elongate chains of atolls, *e. g.*, the maldives, or submerged banks, as the chagos, fall in with the theory. Barrier reefs are similarly explained as due primarily to growth upon accumulations of débris around land.—*Journ. Roy. Microscopical Society, April.*

GEOLOGICAL NEWS.—*Carboniferous.*—Dr. R. H. Traquair (*Geol. Mag.*, Feb.) describes *Aganacanthus striatulus* from selachian spines found in the Blackband ironstone of Borough Lee, near Edinburgh.—In the January number of the same magazine, Dr. Traquair describes *Ctenacanthus costellatus*, a shark from the Lower Carboniferous rocks of Eskdale, Dumfriesshire. It appears to be a Cladodont. In the same issue Dr. Traquair describes *Elonichthys ortholepis*, a ganoid fish from the Lower Carboniferous of Eskdale, Dumfriesshire.—Mr. J. Young notes upon the hinge line of *Spirifera trigonalis*, a denticulated structure like that upon the hinge line of Arca. He regards these denticles as originally formed of aragonite, which is harder than calcite. In the fossils, however, the aragonite has decayed, and has been replaced by a coarser calcite (*Geol. Mag.*, Jan.).—At a recent meeting of the London Geological Society, J. W. Davis described the fishes from the Yoredale series at Leyburn. Of the thirty-four species twenty are identified with known Carboniferous limestone forms, one, *Megalichthys hibberti*, is a coal-measure species, while the remaining thirteen are described as new. Eight of these are regarded as types of new genera.—Dr. E. Tjjetze (Jahrb. Kais. Kon. Geol. Reichanstalt, 1884), contributes an extensive account of the geology of Montenegro. Twenty-three peaks rise to elevations varying from 2000 to 2500 meters. All the principal formations from the palæozoic to the quaternary can be identified with tolerable certainty, but their members are not so well made out. The palæozoic strata consist largely of black or quaternary strata, occur east of Dulcigno, east and north of the Scutarie-see, and at various isolated points. Marine neogene strata are only found between Dulcigno and the coast, and fresh-water strata of similar age do not enter the boundaries of the little principality. The various tertiary strata are grouped along the Adriatic shore, and include nummulitic beds. The Cretaceous strata occupy the largest area, while in the north the Trias is largely developed.—Among the most recent of the memoirs of the Museum of Comparative Zoölogy is an account by C. E. Hamlin, of the results of an examination of the Syrian molluscan fossils, chiefly from Mount Lebanon, collected by Dr. Merrill and Mrs. Bird. Of the twenty-

five Gastropoda, seventeen are new, and of the thirty Lamelli-branchiata sixteen are new. The shells are from the Tertiary, Cretaceous and Jurassic.

BOTANY.¹

ADDITIONAL NOTES ON PASSION FLOWERS.—The following notes and drawings of *Passiflora*, kindly furnished me by Professor Wm. Trelease, of Madison, Wis., are of interest, and should have appeared in connection with my paper on *Passiflora lutea* in the July NATURALIST.—Aug. F. Foerste, Granville, Ohio.



Sections of passion flowers. 1.—*Passiflora gracilis*. 2.—*P. incarnata* (diagrammatic). *n*, nectar gland; *ng*, nectar guard; *c'*, inner corona; *c*, outer corona; *cor.*, corolla; *sep.*, sepals.

"*Passiflora gracilis*.—There is apparently good provision made for crossing, as nectar is secreted by the gland, but the stamens are reached by the very strongly recurved stigmas, so that close (self) pollination occurs about as soon as the flower opens. This results in fertilization, so that all flowers produce fruit. Close pollination, if it should not succeed in the above manner, is sure to occur, as the flowers close at night and so press anthers and stigmas together."² Bot. Gardens, Cambridge, Mass.

¹ Edited by PROF. C. E. BESSEY, Ames, Iowa.

² This power of self-fertilization does not exclude crossing, which is provided for in the secretion of nectar and possibly by prepotency in the pollen of other flowers, if one may reason from the cases in which this peculiarity is demonstrable. As Mr. Henslow suggests (Trans. Linn. Soc., 2d ser., Bot., 1, p. 366) the greater necessity for self-fertility [in case crossing is not effected] here than in related species is to be found in the fact that *P. gracilis* is an annual.

Passiflora incarnata.¹—The three clavate styles radiate outward, curving downward so as to bring their bilobed brown stigmas between the anthers, though they usually stand a little higher and farther from the center of the flower. From the action of bees and wasps, nectar appears to be secreted between the inner row of short filaments, and the base of the column. Large and small bees and wasps visit these flowers and alighting on the colored corona creep in beneath the anthers and insert their tongues in the space surrounding the column or between the bases of the short filaments. In doing this they brush first stigma, then stamen; having begun thus they circle around the column, coming in contact with all the anthers in succession. Small beetles seem to prefer creeping in between the two whorls of long filaments, which they "feel" with their long mandibles. For some reason most of the flowers fail to fruit here, though the plant is wild and they are abundantly visited by bees and wasps, especially the latter. The distance between stamens and pistils and the corona is so great as to enable all but humble bees to creep about on the latter without coming in contact with the anthers or stigmas. Bees collecting pollen creep about, back downward, on the anthers, and often touch the stigmas." Dawson's Sta., Alabama.

A NEW SPECIES OF MOSS.—I send you the description of a new species of moss which has been named by Monsieur Renauld, of Tarbes, France, an eminent bryologist. In my studies of American mosses I came across two species which seemed to be undescribed. This is one of them:

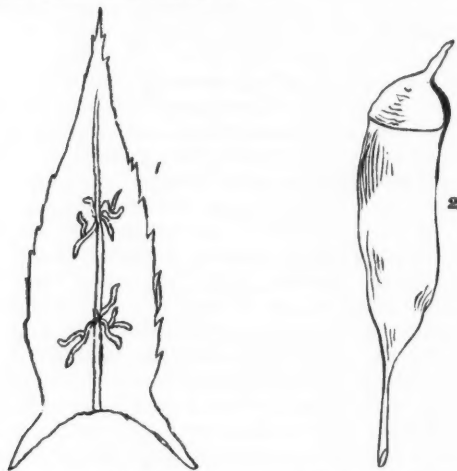
Hypnum (Amblystegium) *Barbéri*, Renauld, species nova.—Monoicum, dense cæspitosum. Caulis erectus 2–4 cent. longus rufo radiculosus subpinnatim ramulosus ramuli sæpe eruti fastigiati. Folia erecta, parva ($\frac{1}{2}$ –1^{mm} longa) lanceolata sensim acutata, decurrentia, ad partem inferiorem remote et *ad basin acute serrata*, apice subintegra. Costa crassa usque ad apicem continua, *dorso radiculis rufo-purpureis ornata*. Rete subdento fere hypnoideo, cellulæ subvermiculares obtusæ—8–12 longiores quam latæ, virides, basilares hyalinæ laxiores subhexagono–quadratæ. Flores masculi parvuli, numerosi; 4–8 antheridia. Perichætium radicans, folia externa ecostata apice recurva interna majores erecta tenuiter costata margine sinuosa. Capsula in pedicello purpureo lævi 3–4 cent. longo, suberecta, vix curvata, collo distincto instructa. Operculum convexo-conicum apiculatum et *sæpe rostellatum*. Anulus angustus *simplex*. Peristomium magnum, pallide luteum, membrana basilaris elata, processus subintegri. Cilia . . . ?

Habitat in loco humido, provinciæ Utah, Am. bor.

The other moss, which I found in Fairmount (west park),

¹ AM. NAT., XIV, p. 362.

proved to be a new variety of *Amblystegium serpens* L., which M. Renauld has called var. *Barberi*.



1.—Folium.

2.—Capsulum et operculum.

Specimens of the Utah species are enclosed.—E. A. Barber, 4101 Walnut street, Philadelphia, Pa.

THE FERTILIZATION OF *PEDICULARIS CANADENSIS*.—Although the fertilization of the genus *Pedicularis* has received considerable attention from European botanists, there are several points which *P. canadensis* illustrates which do not appear to have been noted. This flower is very common about Lansing, Mich., growing on high dry banks where there is but little shade. The yellow variety is about one-third more common than the purple.

The *modus operandi* of the fertilization of this species does not differ essentially from that of its English representative, *P. sylvatica*, which was described by Dr. Ogle in the *Popular Science Review* for 1870. The upper part of the tubular corolla projects forward forming a hood which contains the stamens and pistil. Lubbock¹ describes the rest in the following words: "The anthers open on their inner sides, and the edges of the open anther cells on the one side of the flower exactly correspond with and are applied to the corresponding edges of the anthers on the other side of the flower; each pair of anthers thus forming, as it were, a closed box. The outer sides of the anthers are slightly attached to the walls of the hood. But the sides of the hood are somewhat too near together to admit the head of the humble bee, and the insect, therefore, in order to reach the honey, pushes them a little apart, thus opening the anther box and letting down

¹"British wild flowers in relation to insects," p. 141.

a little shower of pollen which is prevented from spreading by the fringe of hairs on the lower edge of the anther, and thus falls on to the head of the bee, at the very spot which a moment before had touched the stigma, and which will again touch that of the next flower she visits."

The "path-finders" of the flowers of this genus have been described by Dr. Kerner in his interesting treatise on "Flowers and their Unbidden Guests," although he makes no mention of *P. canadensis*. The inside of the lower part of the corolla is studded by numerous short, sharp bristles toward the mouth of the corolla. These form an effectual barrier against any insect passing its tongue to the nectar *via* the short route; were it not for this the fertilizing mechanism would be but seldom utilized, as the humble bees could reach the nectar without poking their heads between the sides of the hood. Ants and other undesirable visitors are excluded by long hairy trichomes pointing outward.

There is a point in the structure of the flowers of *P. canadensis* of which I find no mention as occurring in the European species. It is the curvature of the hood of the corolla; a device which materially aids the bee in reaching the nectar. Supposing a person standing with his back to the stem of the plant, the hood, in the great majority if not all cases, curves to the left. In all instances observed, the bees took advantage of this and lit upon the left.

The flowers are more largely visited by species of bumble-bees (*Bombus*) than any other insect. It is by them that the most of the flowers are fertilized. In one instance observed, a single bee visited one hundred and forty-four flowers in succession, and further observation convinced me that this was less than the usual number visited at one time. As the flowers are arranged spirally on the stem of the plant, the bee usually alights upon the lower flower and follows the spiral upward. In some cases a bee would come to a plant just after another had left it, but would seldom try more than one or two flowers. Finding the nectar gone from these, it seemed to realize that all on the plant had been plundered, and left for greener pastures.

The next most numerous visitors are butterflies of the family Hesperidæ, which during the later portion of the flowering season visit it freely. It is doubtful, however, to what extent they aid in fertilization, as in many cases they do not bring the fertilizing mechanism into use. The same doubt exists as to the fertilizing benefit of the humming birds which visit it to a certain extent. Probably in the case of the latter the prickly path-finders are of but little use. Besides the Hesperidæ a few *Colias philodice* were observed.

In the *Popular Science Review* for 1870, p. 41, Dr. Ogle describes the manner in which humble bees rob the flowers of the cow-wheat by biting through the calyx, and adds; "The very

small calyx admits of this robbery, whereas in red rattle (*P. sylvatica*) the large leafy calyx acts as a safeguard." While this may be and doubtless is true of the English *Pedicularis*, it is not so of our species; notwithstanding the leafy calyx, a large number of the flowers of *P. canadensis* are bitten in just this way. Dr. W. J. Beal informs me that he has observed the same thing in *P. lanceolata*.

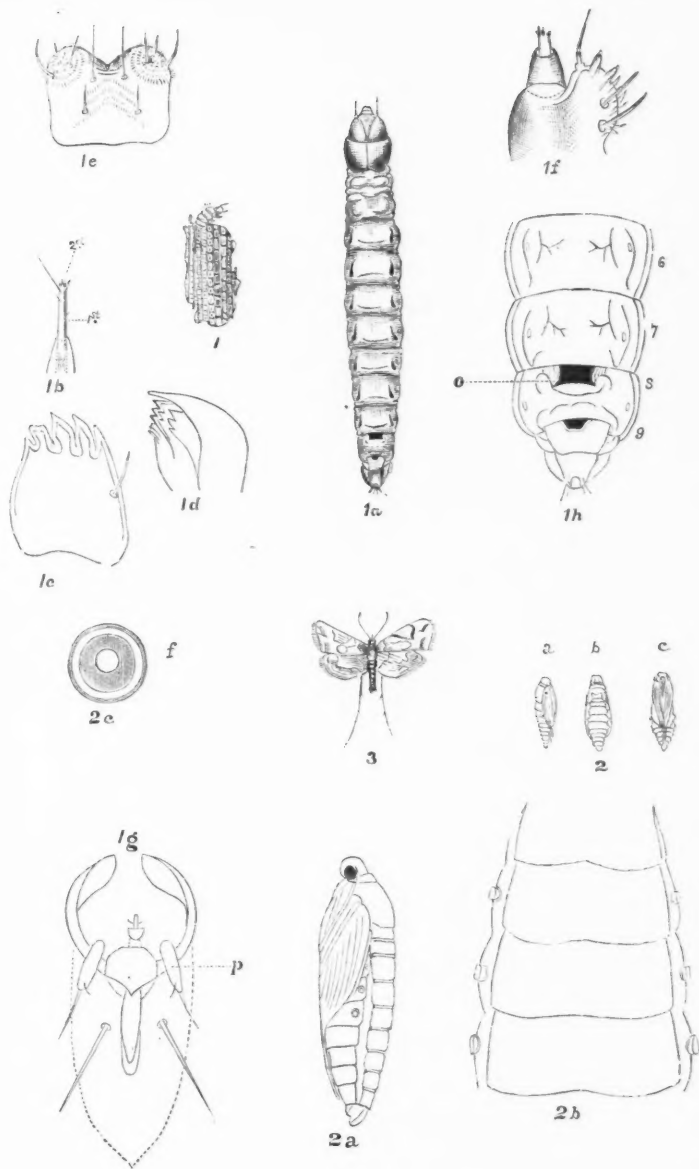
This species illustrates an interesting point in regard to the relative time of secretion of nectar and the opening of the flower. In most flowers it is naturally supposed that the nectar is not secreted until the corolla is about to open. Dr. Ogle has shown that this is the case in the cow-wheat. In *P. canadensis*, however, the bee and butterfly visitors habitually plunder the buds by thrusting their tongues in between the folds of the corolla. Very often they thus plunder buds in which the corolla projects less than a quarter of an inch from the calyx, at least several days before the flowers will open. They certainly would not do this did they not obtain nectar. That a certain amount of honey is also secreted after the corolla falls off is shown by the number of ants which visit the empty calyces, as well as the occasional honey bees which visit them.—*Clarence M. Weed, Lansing, Mich.*

ENTOMOLOGY.

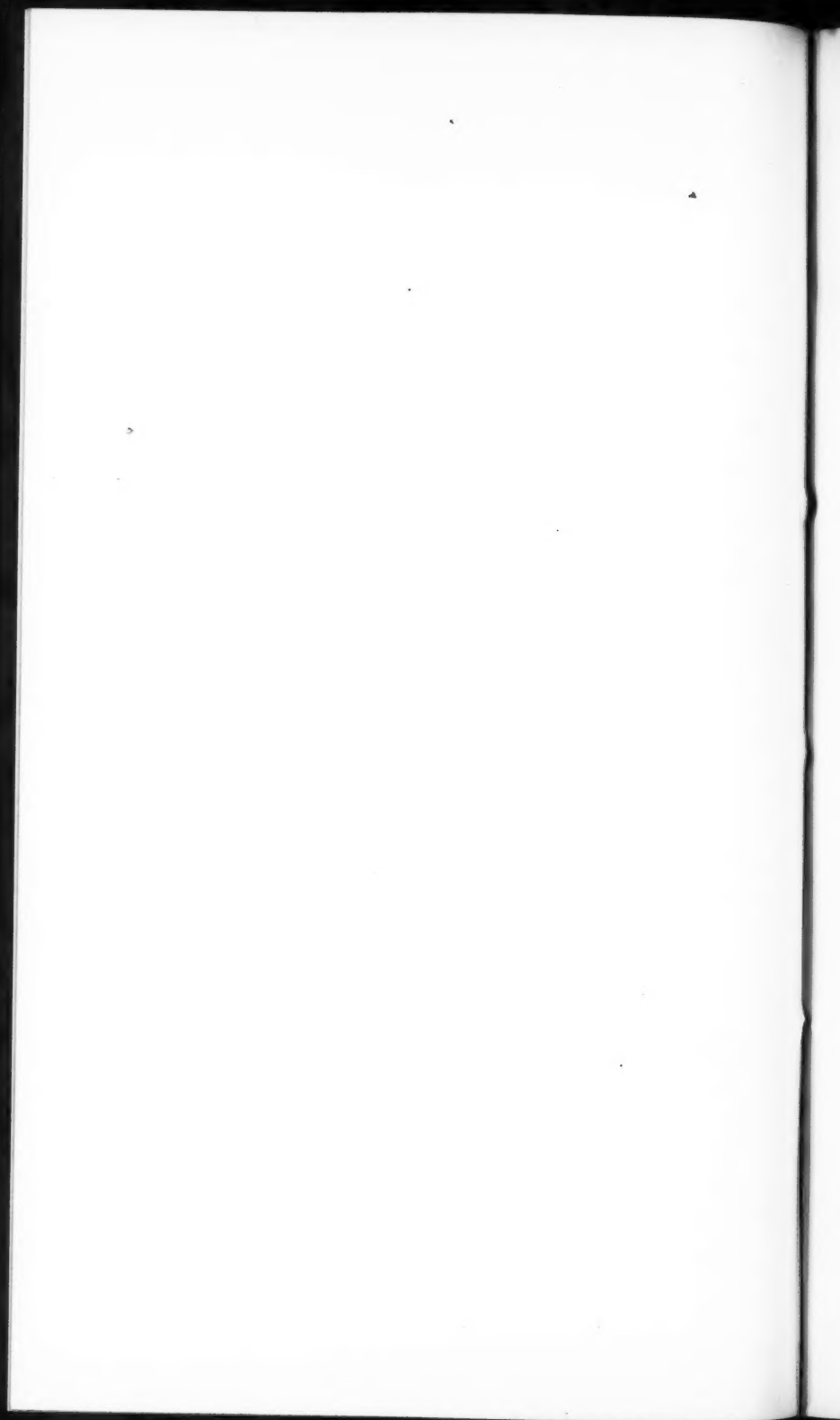
HABITS OF AN AQUATIC PYRALID CATERPILLAR.—The habits of the caterpillars of the Hydrocampinae, a group of Pyralid moths, are unusually interesting, and deserve special attention in this country. We quote from Guenée the following account of them: "The principal title of the family of Hydrocampidæ to the notice of observers, resides in the habits of their caterpillars. Our three most popular entomologists, Réaumur, De Geer and Lyonnet, have observed and described them with all the details fitted for a subject so curious, and have not, so to speak, left anything for their successors to do; I will then give here a hasty analysis of their works. These caterpillars live on the leaves of several aquatic plants, *Nymphæa*, *Potamogeton*, *Lemna*, *Stratiotes*, *Calitiche*, etc., and as most of these plants are, in part, submerged or floating, or at least surrounded with water, it is necessary for our larvæ to have exceptional means of passing through the water, and even of living in almost constant contact with it. It is this which nature has provided, not in a uniform manner, but by varying its means with its ordinary fecundity."

The larva of *Cataclysta*, he says, feeds on leaves too small to enable it to be contained between them, it therefore constructs a cylindrical tube of silk, and strengthens it with leaves placed on the upper side. The case differs from that of *Hydrocampa* in that the tube it constructs is not like a sheath and formed of two bits of leaves, but is broadly cylindrical or oval, and strengthened all around by small leaves of *Lemna*. Moreover the caterpillar

PLATE XXIV.



Transformations of *Hydrocampa formosalis*.



lives submerged in the water and attached to the under surface of floating leaves. Its case serves as a cocoon within which to pupate, and it is attached to some aquatic plant. The chrysalis is soft, with the ventral sheath prolonged to the end of the abdomen.

The most curious caterpillar is that of *Paraponyx*, living on plants wholly submerged; it is provided with gills which allow them to decompose the air contained in the water; and they are, as De Geer showed, truly amphibious, because they are provided at the same time with stigmata to respire ordinary air, like other caterpillars.

The caterpillar appears, at first sight, as if furnished with respiratory filaments of different lengths, three or four arising from a common tubercle. It is the only lepidopterous larva known to be provided with tracheary gills.

The chrysalis lives also wholly submerged, constructing between the submerged leaves of the plant which nourishes it, a cocoon composed of a double lining of silk, wherein it changes into a chrysalis. The imago has to pass through the water on leaving its cocoon, so that it is at the beginning of its existence also amphibious.

The last genus, *Hydrocampa*, has caterpillars which are rather thick, attenuated at each end, flattened beneath, with a small retractile head. They live under the leaves of pond lilies in a pod-like sac formed of two bits of leaves stuck together at their edges.

The accompanying drawings, made by Dr. C. F. Gissler, undoubtedly represent a *Hydrocampa* larva. I found it in great abundance May 20, 1882, in its case, made from the leaves of *Menyanthes trifoliata*, in a swamp at Providence, R. I. I failed to prepare a full description either of the larva or pupa, but think that the figures on Plate xxiv, prepared by Dr. Gissler, will enable it to be recognized. I have introduced a figure of the moth, which was observed in great numbers flying over the surface of the water, many being drowned. The larvæ (Fig. 1) were observed living between two pieces of *Menyanthes* leaves, fastened together on the sides. The pod-like sac was oblong, but quite irregular in shape. The caterpillar was dull in color and active in its habits, thrusting its head and three following segments in and out of its case. Fig. 1 represents the worm in its case of natural size; 1a, the caterpillar enlarged about six times; 1b, an antenna; 1c, 1d, the mandibles; 1e, the labrum, much magnified; 1f, the maxilla; 1g, the labium, and p, the palpus; 1h, the end of the body, dorsal view, showing at o a large cleft which can be closed by two lateral fleshy lobes and a posterior fleshy bead; on the succeeding segment is a smaller cleft; the spiracles are seen on the sides of the same segments.

The few caterpillars which I carried home began to spin a

cocoon within the case from June 4-10th; the moths being noticed June 12-13th.

The pupa (Fig. 2-2c), 2, natural size, bulges out considerably on the 4th and 5th abdominal segments. There are only three pairs of spiracles, *i. e.*, on the 2d, 3d and 4th abdominal segments. One of these spiracles (highly magnified) is represented at 2c; their relations to the body at 2b.

The moth was not directly raised from the pupa, but the former were so thick that I have little doubt but that the *Hydrocampæ* captured at the same spot a few days after the larvæ were found, were the imagines of the larvæ under consideration. Seeking for them the next year, none were to be found, though very prolonged search was not made for them for want of time.

The moth found so abundantly, and seen on the following summer at the same date as above recorded, was *Hydrocampæ formosalis* of Clemens (Fig. 3. The drawing is a very poor one).

We have in this country four species of *Hydrocampæ*, five of *Cataclysta* and five of *Paraponyx*, and it is to be hoped that many years will not elapse before the larvæ, at least those of the latter-named genus, will be discovered. It is hoped that this note will serve to draw attention to these very curious insects.—*A. S. Packard, Jr.*

NOTES ON SALT-WATER INSECTS, NO. III.—Our first article on this interesting subject appeared in the Proceedings of the Essex Institute, Salem, VI, 1869; a second article was published in the *American Journal of Science*, I, Feb., 1871. The present contribution will be a brief one, being a description of a dipterous larva found in the ocean Aug. 28th, on the coast of New Jersey, and forwarded to us alive by Professor A. E. Verrill several years ago; and also of a new species of mite, received at the same time and from the same source.

The body is white, long and slender, cylindrical, tapering gradually from the penultimate segment towards the head; there being twelve segments behind the head. The segments are smooth, but thickened at the hinder edge, the sutures being distinct. The tegument is very thin and transparent, allowing the viscera to be easily distinguished. The terminal segment of the body is conical; seen from beneath it is nearly one-quarter longer than broad, the end subacute and deeply cleft by a furrow which diminishes in size and depth to beyond the middle of the segment, where it fades out. This conical extension is flattened vertically. Above from the middle

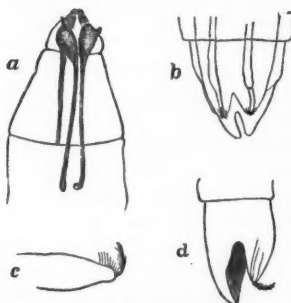


FIG. 1.—Salt-water maggot.

which diminishes in size and depth to beyond the middle of the segment, where it fades out. This conical extension is flattened vertically. Above from the middle

of the same segment project two supra-anal, conical, fleshy, respiratory tubercles, one-fourth the length of the entire segment, which separate and close together at the will of the animal. These two tubercles (*b*) give rise to two main longitudinal tracheæ which extend to the head; they end in a tuft of fine setæ.

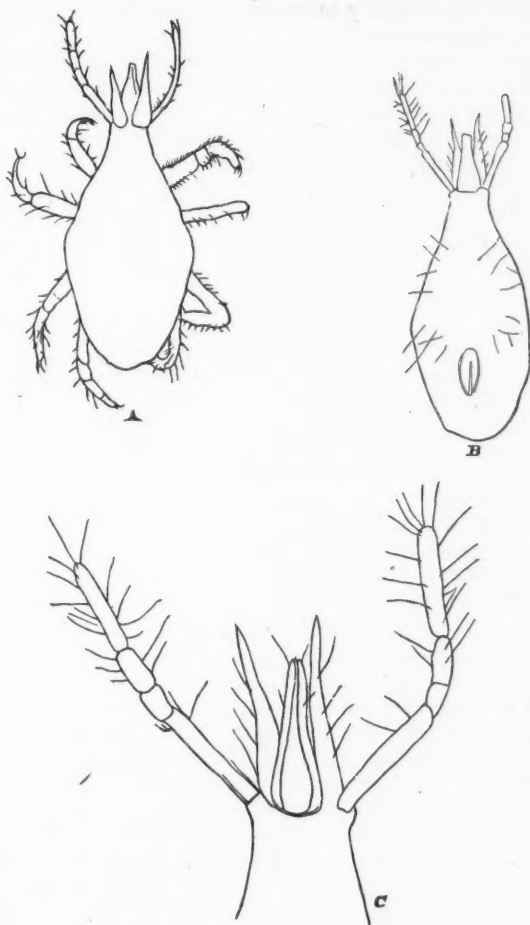


FIG. 2.—*Bdella marina* Pack.

When extended the prothoracic segment is considerably longer than the others. The head is one-third as large as the prothorax and a little more than half as wide. Length .35 inch.

I could not detect any spiracles on either of the thoracic seg-

ments. The tracheæ are not nearly so regular as in the larva of *Anthomyia ceparum*, by the side of which I placed it; though the present larva scarcely appears to belong to the Muscidae, as there are minute antennæ present, there being no trace of them in the muscid larvæ as a rule.

As represented in the figure at *b*, dorsal view, and *d*, lateral view, two main tracheæ end each in a large dorsal tubercle, each with a tuft of fine respiratory setæ; the cleft ventral plate being fleshy at the tips. One of the respiratory tubercles is represented as seen from the side at *c*; it gives rise to a fan-like series of radiating fine setæ, which are directed upwards and a little forwards towards the base of the tubercle.

A new species of mite was also received from New Jersey through Professor Verrill, which was found living in the sea. It may receive the name of *Bdella marina* (Fig. 2: *A*, upper; *B*, under view; *C*, enlarged view of the proboscis and 2d pair of cephalic appendages, the so-called maxillæ).

The body is slender, pear-shaped; it is apparently eyeless, and the legs are no longer than the body is broad. The proboscis is long, conical; the maxillæ long and slender, acute; extending some distance beyond the end of the proboscis. The maxillary palpi are 4-jointed; the basal a third longer than the two following ones taken together, while the 4th (and last) is a little shorter than the basal joint. (The right palpus is not correctly engraved.) The description is drawn up from camera drawings, the specimen having been lost or mislaid. I cannot state the exact size or color of the animal. It was collected on the shore, but living immersed in the salt water, as I understand from Professor Verrill.—*A. S. Packard, Jr.*

ENTOMOLOGICAL NOTES.—An extraordinary helix-like Psychid case, from East Africa, is reported and figured by Mr. R. McLachlan in the *Entomologists' Monthly Magazine* for June. The case is high and resembles shells of the genus *Cyclostoma* or *Paludina* in a wonderful degree. In some the spiral turns from left to right, in others from right to left. The texture is perfectly hard and firm, and somewhat fibrous.—The Bulletin of the Brooklyn Entomological Society, No. 2, is occupied by an essay preliminary to a monograph of the genus *Catocala*, by Rev. E. D. Hulst. It is illustrated by a plate of details of the external anatomy of these moths, especially the femoral spurs, claspers, and tarsal claws of different species. This society is doing useful work in publishing such synopses and monographs as already have and are promised to appear. We quite agree with Mr. Hulst in his remark that the genus *Catocala* occupies a position between the typical Noctuids and Geometrids, and that it ought to be placed closer to the first than it is, near *Ypsia*, Homoptera and its allies, and that these, "with Euclidia, ought to be almost,

if not quite, at the end of the Noctuidæ."——Francis G. Sanborn, well known as a zealous and enthusiastic collector of insects, and a useful museum assistant, died suddenly June 5th, aged 46, while on a visit to Providence, at the house of George Hunt, Esq. He was one of the curators of the Natural History Society of Worcester. He was an amiable, generous man, and lepidopterists owe much to his willingness to communicate the rarities which he captured.——According to the researches of M. G. Carlet, the muscles of the abdomen of the bee are more numerous than they were supposed to be and, with the exception of the aliform muscles, which subserve circulation, are employed in respiration and consequently in calorification, which is important in the bee's economy. Thus the mechanism of respiration is more complicated than was before believed, since there is not only a lengthening and shortening of the abdomen, but an alternate approach and separation of its dorsal and ventral walls.——M. Ch. Brongniart, in his work upon the fossil insects of the coal beds of Commeny, describes a gigantic neuropter of the curious group of the Dictyoneura. This group contains insects which measure at least half a meter in length and 0.70^m or about two feet four inches in spread of wings.

ZOÖLOGY.

A NEW INFUSORIAN BELONGING TO THE GENUS VORTICELLA.—The following heretofore undescribed infusorian occurs sparingly on the leaflets of *Ceratophyllum* in a pond near to, and often connected with, the Delaware river at Trenton, N. J.:

Vorticella lockwoodii, sp. nov.—Body when expanded broadly campanulate, not conspicuously changeable in form, the length about equaling the width, tapering posteriorly to the pedicel, and constricted beneath the border of the peristome, which is everted and equal in breadth to the entire length of the body; subspherical when contracted, and anteriorly crenulated; ciliary disc not elevated; cuticular surface bearing numerous scattered hemispherical or ovate elevations, diverse in size and usually collected about the equatorial region into irregularly disposed series, each prominence enclosing a nuclear nodule; parenchyma finely granular; contractile vesicles *two*, small, spherical, pulsating alternately; one placed somewhat above and in front of the other, near the pharyngeal passage; pedicel four to five times longer than the body. Length of the body and width of the expanded peristome field $\frac{31}{100}$ inch; width of the pedicel $\frac{30}{100}$ inch. Habitat, pond water. Solitary or few together.

The characteristics by which this form may be readily distinguished from all Vorticellæ, are the existence and structure of the cuticular prominences and the undoubted presence of *two* contractile vesicles. The latter are in contour and position as stated above, but the writer would emphasize the fact of their duality. Hitherto no member of the genus has been observed with more than one pulsating vacuole, the latest generic diagnosis describing it as single without exception. The representation in the figure (Fig. 1, magnified 400 diameters) is somewhat diagrammatic, as both cannot be brought into focus at the same

time. When the circular outline of one is distinctly visible, the

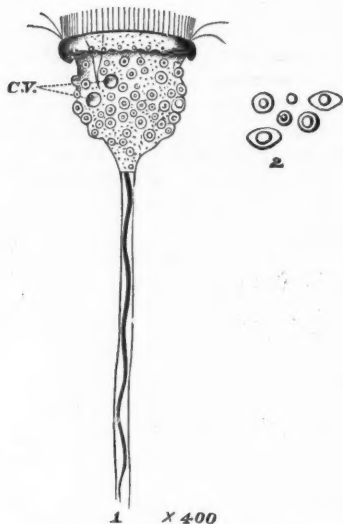


FIG. 1.—*Vorticella lockwoodii*, sp. nov. FIG. 2.—Cuticular elevations much enlarged.

ing on the same individual. The shape of the enclosed nucleus is uniformly the same in both, being that of a small circular disc, but that these internal bodies are disciform and not spherical, I have not been able to positively determine. They are, however, probably spherical.

The anterior and posterior regions of the body are, in some individuals, almost naked, while the cuticular prominences are usually more numerous centrally, with a tendency to collect into a more or less conspicuous equatorial zone. Some of the constituents of this belt, with their apparently disc-shaped nuclei, are shown greatly enlarged in Fig. 2.

It affords me much pleasure to dedicate this remarkable member of a remarkable genus to the Rev. Samuel Lockwood, Ph.D., an illustrious naturalist by whose friendship I am honored.—*Alfred C. Stokes, M.D.*

A NEW SPECIES OF INFUSORIAN.—In the Proceedings of the Canadian Institute, Vol. 1, Part 4, I described a *Metopus* occurring in water from a small pool in the neighborhood of Guelph, Canada, expressing an opinion that it constituted a new species, but refraining from naming it until I should have had an opportunity of examining other specimens. Lately I have found several examples in sediment from cistern water in the same city, the

pulsations only of the other can be distinguished; with a homogeneous immersion $\frac{1}{8}$ inch objective, however, and the one inch (C) ocular, giving an amplification of nearly a thousand diameters, the systole of each can be seen alternately by manipulating the fine adjustment screw during the diastole, or *vice versa*.

The cuticular elevations are arranged in a series on the margin of the peristome border, but the nuclear bodies are there small and frequently obscure or absent. The prominences vary much in size even where most abundant. In contour they are generally hemispherical, but occasionally their outline is ovate, the two forms occur-

study of which has convinced me of the correctness of my supposition.

Only one species of *Metopus* has hitherto been described, *M. sigmoides* Cl. & L., and under it Stein includes several varieties characterized by difference in form, but passing into each other by gradations, the same individual assuming different shapes at different periods of its existence, so that a mere difference in outline cannot be considered as a sufficient cause for the establishment of a new species. Stein describes three well-marked forms, the normal, the shortened and the rolled up. The individual described in the paper mentioned above was of the normal shape, those I have lately found may be described as belonging to the shortened type. The annexed figure represents one of them tolerably correctly.

They measured about $.08^{\text{mm}}$, while the normal form was about double that, or $.17^{\text{mm}}$. At first sight they recalled the form of a young *Polygordius* larva. The bent-over portion constitutes about one-half of the entire animal, and lies in a plane parallel to that of the posterior portion of the body which tapers somewhat suddenly posteriorly, so as to have a slightly pyriform outline. The axis of the bent-over portion, or "stirn-kuppe," is almost at right angles with that of the posterior portion. In the "stirn-kuppe" are a number of strongly refracting granules, as figured by Stein, and the body is terminated posteriorly by a bunch of bristle-like cilia.

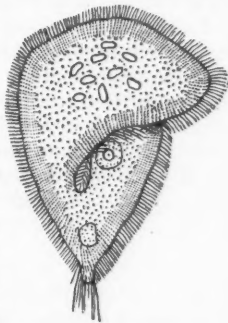


FIG. 1.—*Metopus striatus*.

The chief points wherein this shortened form differs from that described by Stein are as follows.

1st. The greater bending over of the anterior portion of the body, so that it is at right angles to the posterior portion.

2d. The greater breadth of the body in comparison to its length, and the abrupt tapering posteriorly.

3d. The striation of the border of the body.

In the description of the normal form I indicated the features in which it differs from Stein's; certain of these are still recognizable in the shortened form, others have disappeared, and others I did not have an opportunity of deciding upon. The plane of the bent-over portion in the normal form is at right angles to that of the posterior portion, in the shortened form it is parallel. The anal aperture I was not able to detect in the shortened form, but only one contractile vesicle, situated posteriorly, was present; the second anterior vesicle seen in a normal form was probably pathological, since it was not observed until after some days had elapsed since the animalcules had been placed in confinement be-

low the cover-glass. The striation of the border of the body was well marked in both forms, and was one of the most noticeable features. It has not been represented in any figures of *M. sigmoides*, and it may be concluded that it was absent, for if present it could not fail to have been delineated. On account of this peculiarity, present in both the forms, which resemble each other so slightly, but which are evidently the same species, I propose to name the form *M. striatus*. Although certain features characteristic of the normal form are thus absent from the shortened, still the normal form and that of *M. sigmoides* have very distinct differences, and so with the two shortened forms, and there is therefore a strong probability of the distinctness of the species.

I may mention here that for killing Infusoria, provided only a temporary preparation is required, I find a saturated solution of corrosive sublimate in water the most useful of any I have tried.¹ A drop or two run under the cover-glass produces almost instant death without any of the shrinkage so annoying even with osmic acid. After this treatment I find that staining with aniline blue, black or Bismarck brown takes place very rapidly and very satisfactorily.—*J. Playfair McMurrich, Agricultural College, Guelph, Canada.*

LIFE-HISTORY OF THE HYPOPUS STAGE OF CERTAIN MITES.— From a careful series of experiments and observations, Mr. A. D. Michael, in a paper read to the Linnean Society of London, concludes that true "Hypopi" are not adult animals, but only a stage, or heteromorphous nymphs of Tyroglyphus and allied genera. Nor do all individuals become "Hypopi," which latter stage takes place during the second nymphal ecdysis. It seems a provision of nature for the distribution of the species irrespective of adverse conditions. "Hypopi" are not truly parasitic, nor do they confine themselves to any particular insect. A new adult form described is called by the author *Disparipes bombi*, and he believes there are other species of the genus. Donnadieu's bee-parasites are admitted to be adults, though it is uncertain if they are identical with Dufour's *Trichodactylus*.

DOES THE CROW BLACKBIRD EAT CRAYFISH?— In the NATURALIST for November, 1881, this question is asked by Professor F. E. L. Beal, of the Iowa Agricultural College; in answer to it Mr. Charles Aldrich, in the January, '82, NATURALIST, says it probably does, as he has seen a crayfish in the jaws of a blackbird. A few days ago, while investigating the food of some young blackbirds taken from a nest in an evergreen near the river, I found an abdomen of a crayfish in one of the stomachs, thus proving beyond all doubt that the young, at least, do eat crayfish.—*Clarence M. Weed, Mich. Agr. Col.*

¹ Meckel's fluid with acetic acid, as recommended by Brass, I have not yet tested.

ZOOLOGICAL RESULTS OF THE ROMANCHE EXPEDITION TO CAPE HORN.—Among the treasures gathered by this expedition and exhibited in the Palais de l'Industrie, are a skeleton of *Balenoptera sibbaldii*, another of *B. patachonica*, several of *Otaria jubata*, a single specimen of *Vespertilio chilensis*, several examples, some living, of the small domestic dog of the Fuegians, a *Lutra felina* and four species of *Mus*, two of which, *M. flavescens* and *M. xanthorhinus*, are rare. Out of 477 examples of Aves only forty species are terrestrial. Among the penguins *Microdyptes serresiana* has hitherto been known from a single specimen only. Among the fishes *Lycodes obscurus*, a species related to *Cyclopterus*, and the genus *Lepidochnictys* are new. Fresh-water fishes are represented by *Galaxias maculatus* and *Notothenia tessellata*. The predominating genera of mollusks are *Oscabrion*, *Patella* and *Mytilus*. All the large species are edible. The large mussel shells, fixed upon a stone handle, are used by the Fuegians as knives.

Among the mollusks are Chitons, Volutes, Succineas and Chilias, many of them new, but there are no fresh-water shells, and only three or four small Helices. Echini, which are a valued article of food to the Fuegians in July and August (the end of winter) are abundant, and the starfishes include *Labidiaster radiosus*, which has evident relations to *Brisinga*, and *Ctenodiscus australis*. The collection of insects is not only interesting on account of the new species, but because of numerous forms which were previously known only from parts of South America near the equator.

ZOOLOGICAL NOTES.—*Sponges*.—The *Challenger* report upon the calcareous sponges is the work of Mr. A. Polejaeff, of Gratz. Thirty species were recognized, twenty-three of which are new. The author places the sponges among the Cœlenterata as a subclass, of which the group of calcareous sponges constitutes the two orders of Homocœla (*Asconidæ*) and Heterocœla, with the three families *Syconidæ*, *Leuconidæ* and *Teichonidæ*.

Cœlenterates.—H. W. Conn and H. G. Beyer (Stud. from the Biol. Lab. J. Hopk. Univ., 1883), describe the various nerve structures of *Porpita*. These consist of nerve ganglion cells, about $\frac{1}{2000}$ of an inch in diameter, usually tripolar, but sometimes bipolar, with a thread-like process from each pole; and of some hundreds of small ectodermal pockets arranged around the edge of the velum. These pockets are formed of much enlarged ectodermal cells, some of which have a distinct nucleus and nucleolus. They would seem to be organs of touch.

Mollusks.—By far the greater part, if not the whole, of the primitive kidneys of *Helix* have been ascertained by M. P. de Meuron to be of ectodermal origin. The walls of these organs have all the characters of regular epithelium, there is a wide external opening,

and M. de Meuron is convinced of the existence of an internal orifice furnished with vibratile cilia directed backwards. The true kidneys in the same genus are composed partly of an ectodermal invagination, and partly of mesodermal structure. The two parts unite early and so closely that they cannot be distinguished. The kidney then increases rapidly and takes the shape of the letter S, one extremity terminating at the bottom of a fold of the pallial cavity, while the other opens into that of the pericardium. M. Grobben considers the cavity of the pericardium as the remains of the primitive coeloma, but M. de Meuron sees in it the cavity of the posterior of the two somites of a mollusk. The primitive kidneys thus represent the excretory organ of the first somite; and the true kidneys that of the second somite.—Professor H. L. Osborn (Stud. from the Biol. Lab. J. Hopk. Univ.), gives an account of his studies upon the structure and growth of the shell of the oyster. A thin circular glass was inserted between the outside of the mantle and the inside of the shell, and the secretion examined. After twenty-four hours a thin gummy deposit, with in some cases a few lime crystals, was found. This was clearly a viscid secretion from the surface cells of the mantle. In a second twenty-four hours the glass was enveloped in a leathery brown membrane, like the epidermis of a shell, but containing calcium carbonate in solution. A film six days old had lost its leathery character and become strong, and after three or four weeks the glass is completely coated with white shell, principally formed of the mother-of-pearl layer.

Crustaceans.—The *Challenger* report upon the Cirripedia is by Dr. P. P. C. Hoek. Seventy-eight species are represented, only nineteen of which were previously known. Of the thirty-four genera of Cirripedia now known, twenty-eight have not been found below 150 fathoms; two occur from the shore to 400 fathoms, *Balanus* reaches to 510 fathoms, *Dichelaspis* to 1000, and *Scalpellum* and *Verruca* have been observed below 1000 fathoms. Forty species of *Scalpellum* were added by the *Challenger* to the eleven before known. As with fossil *Scalpellum*, the species are numerous, the individuals rare. Ten species of *Verruca* were found, six of them new. The distribution of this genus is world-wide, and the six new species inhabit depths of from 500 to 1900 fathoms.—The *Challenger* report of Dr. G. S. Brady on the Copepoda contains descriptions of 106 species, including eleven new genera. The specimens were almost entirely taken with a surface net. From the equator to the poles it seems certain that the ocean supports everywhere an abundance of Entomostraca, chiefly Copepoda, and the cold waters of the polar regions seem even more favorable to these animals than the tropics. The species, as a rule, have a wide distribution, but some, as *Calanus finmarchicus*, seem to be arctic, while others, as *Undina darwinii* and *Euchaeta prestandreae* belong to warmer seas. The only

undoubted deep-sea species is *Pontostratiotes abyssicola*, dredged in 2200 fathoms. This was previously described in MS. by Dr. von Willemoes Suhm as *Lernæa abyssicola* and was found on *Ceratiis uranoscopus* dredged in 2400 fathoms.

Tunicates.—M. L. Roule has studied the genus *Rhopalea*, an ascidian abundant near Marseilles at a depth of fifty to sixty meters. *Rhopalea* does not reproduce by budding, and may be considered as forming a link between the simple and the compound tunicates.

Batrachians.—M. G. Calmels finds in the poison of batrachians a small portion of methylcarbylamine, which gives to the liquid some of its odor and toxic qualities; it also contains, in larger quantities, an acid from which the methylcarbylamine is formed.

Birds.—Herr Stieneger informs *Naturen* that Kamtschatka has four species of sea-eagle, *Haliaëtus hypoleucus*, *H. albicilla*, *H. leucocephalus*, and *Thalassaëtus pelagicus*. The first of these is distinguished from the others by the dazzling whiteness of some parts of the body and by its generally lighter color. Among the cetacean crania collected, three seem to belong to a new species.

Mammals.—Dr. P. Albrecht, in a communication to the Anthropological Society of Brussels, maintains that there are primitively four intermaxillaries, and that hare-lip, which is never central, takes place by the separation of the inner and outer intermaxillaries of one or the other side. As proof of this, he figures cases of double hare-lip, in which the two inner bones (endognathia) stand out as a separate bone anchylosed in the median line, while each outer intermaxillary, bearing its incisor, is united to the maxillary. In the *Ornithorhynchus*, as figured in a communication of the same observer to the Pathological Society of Brussels, the two outer intermaxillaries (mesognathia) are large and widely separated, while between them, but further back, is a single bone, which is by M. Albrecht homologized with the endognathia. On each side of this is an incisive canal. Behind the mesognathia are two large submaxillaries or exognathia.

PHYSIOLOGY.¹

CONNECTION BETWEEN PHYSIOLOGICAL ACTION AND CHEMICAL CONSTITUTION OF DRUGS.—Dr. Blake states very confidently that a physiological classification may be made of chemical substances according to their isomorphism and atomic weights. Isomorphous substances, regardless of chemical composition, have the same general physiological action. He found, moreover, "that amongst the salts of the metallic elements the intensity of their physiological action was connected with the atomic weight of the element, so that when the elements are arranged in isomorphous

¹This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

groups, the action of substances in the same isomorphous group is a function of the atomic weight, the greater the atomic weight the smaller the quantity required to produce the same physiological action." The author divides the chemical elements into ten groups, in each of which, among the metals, with one exception, the salts are isomorphous and have characteristic physiological actions which are described in detail.—*Jl. of Physiology, Vol. v, No. 1.*

THE ACCELERATOR AND INHIBITORY NERVES OF THE HEART OF COLD-BLOODED ANIMALS.—The heart of the frog is connected with the central nervous system only through branches of the vagus nerves, while in the higher animals the heart is separately supplied by the vagus and fibers from the ganglia of the sympathetic system. When the sympathetic branches are cut and their peripheral or heart ends are stimulated, the rate of heart-beat is quickened. But the reverse effect follows when either vagus nerve is treated in the same way; the heart-beat in this case being retarded or stopped. It is accordingly believed that the sympathetic heart-nerves are efferent accelerator nerves, while the fibers of the vagus have a cardio-inhibitory function. But in the case of the frog Gaskell finds that stimulation of the vagus, which is the only heart-nerve, may: "1. Slow or accelerate the rate of the beat; 2. Diminish or augment the force of the contractions both of auricle and ventricle; 3. Lessen or increase the excitability of the cardiac muscle; 4. Diminish or improve the conduction power of the muscular tissue. Such opposing effects are evidently due to one of two causes, either (1) to the joint stimulation of nerves belonging to two separate nerve systems of which the one system contains purely inhibitory and the other purely augmentor (accelerator) fibers; or else (2) to the stimulation of nerves which are able sometimes to augment, sometimes to inhibit the cardiac functions according to varying conditions of the nerves or of the heart itself. In order to decide between these two hypotheses, it seemed to me advisable to find a cold-blooded animal possessing definite accelerator nerves, so as to see whether the sympathetic system provided the heart entirely with augmentor fibers while the vagus contained only inhibitory. For this purpose I selected the crocodile as being the most likely of all cold-blooded animals to possess a nervous system closely resembling that of the warm-blooded. My expectations were fully answered; the accelerator nerves of the crocodile leave the main sympathetic chain at a large ganglion corresponding apparently to the ganglion stellatum of warm-blooded animals, and accompany the vertebral artery up to the superior vena cava, where they leave the artery and passing alongside the vein anastomose with branches of the vagus in the neighborhood of the heart. Stimulation of these nerves increases the rate of the car-

diac rhythm and augments the force of the auricular contractions, while stimulation of the vagus slows the rhythm and diminishes the strength of the auricular contractions."

Guided by these facts the author was successfully led to attempt to isolate the sympathetic nerve twigs which join the cranial vagus in the frog near its exit from the skull, and the following are the physiological results obtained :

"Stimulation of the sympathetic before its entrance into the combined ganglion of the sympathetic and vagus, produces purely augmentor (accelerator) effects. Stimulation of the vagus within the cranial cavity before its entrance into the ganglion, produces purely inhibitory effects."

The communication is of special value in removing a doubt as to whether the action of individual nerves is physiologically invariable or capable of being altered under changed conditions. —*Jl. Physiology, Vol. v, No. 1.*

THE TIME TAKEN BY THE BLOOD IN MAKING THE CIRCUIT OF THE BODY.—Dr. Smith, in describing a new method for determining the velocity of the blood current, calls attention to the inaccuracy of the old experiments by which it was sought to find the rate of circulation by measuring the time elapsing between the injection of an iron salt into one jugular vein and its appearance in the jugular on the other side of the neck. Various chemical substances in solution make this circuit in very different periods, because, apparently, of their different diffusibility. According to the method now considered, de-fibrinated pigeon's blood is injected into one jugular vein of an animal whose blood is allowed to drop from the other jugular into a series of watch-glasses placed in a circle upon a table which is revolved by clock-work. Microscopic examination of the blood thus collected is made to determine in which watch-glass the oval corpuscles of the pigeon's blood first appear ; then knowing the rate at which the table is turned it is easy to estimate the time taken by the pigeon's blood in passing from one jugular to the other, in which passage it has probably traversed not only the heart and lungs, but the capillaries of the head as well. The mean of six experiments gives the time of circulation in the dog as 17.5 seconds, during which the heart made 51.5 pulsations. In the rabbit the time of circulation was 11 seconds, during which there were 31 heart-beats. When solid particles are injected into a moving current, as the blood, the heavier ones are carried at a faster rate than the lighter, because the former are more readily drawn into the swiftly moving axial current. Thus in the living blood-vessels, the heavier red corpuscles are confined to the central core or axial current, while the lighter leucocytes occur chiefly in the outer "inert" layer. The author finds that very finely divided carmine particles suspended in a fluid require twice as long to

pass from one jugular to the other as do the corpuscles of pigeon's blood, and the mean velocity of the current lies somewhere between the two rates determined.—*Am. Jl. Med. Sci., No. CLXXIV.*

PSYCHOLOGY.

THE NATURE OF INSTINCT.—This subject has lately been discussed by Messrs. Romanes and C. Lloyd Morgan. As to the view that there is a science of comparative psychology as held by Romanes and others, Mr. Morgan inquires, in *Nature* for Feb. 14, (1) Whether there is a science of comparative psychology; (2) discusses the place of consciousness; (3) the lapse of consciousness; (4) a psychological definition of instinct; (5) a physiological definition of instinct; (6) the origin and development of instinct. Mr. Morgan thus concludes:

1. While fully admitting the great interest that attaches to the study of the inferred mental faculties of the higher brutes, I believe that, from the ejective nature of the animal mind and the necessary absence of verification, no science of comparative psychology, except such as is restricted to "objective psychology," is possible.

2. Of the four views of the place of consciousness in the animal world, only one—that of *free will*—renders the study of the actions of animals incapable of scientific treatment. Of the other three I believe *determinism* to be the most satisfactory. According to this view both neuroses and psychoses are subject to law. But from our necessarily ejective knowledge of psychoses, we are forced to confine our attention (from the scientific point of view) to the objective phenomena of neurosis, especially as manifested in conduct; of the psychoses, we can know nothing with certainty; of the neuroses we may learn a little; of conduct we may learn much.

3. From the principle of the lapse of consciousness certain corollaries may be drawn: (a) That it is difficult or impossible to say what amount of consciousness, if any, an action performed by my neighbor involves; (b) that it would seem probable that the lapse of consciousness in the individual is paralleled by a lapse of consciousness in the species; and (c) that the hypothesis that instinctive actions are unconscious is incapable of disproof.

4. On the general ground given in 1, and on the special ground given in 3, I see great difficulties in accepting the psychological theory of instinct—that instinct is reflex action into which is imported the element of consciousness.

5. In accordance with the principle thus advocated, a physiological definition of instinct must be sought. Some such definition as this may be proposed: *Instinctive actions* are actions performed by the individual in virtue of his possession of a special

type of nervous organization, that is, a type of organization common to his species.

6. The question of the origin and development of instincts thus becomes a question as to how this special type of structure has been evolved. It takes its place as part of the general question of the evolution of structures—the actions being the external manifestations of internal structures. To the question as to the relative importance of direct and indirect equilibration I could give no definite answer within the limits of this article, and therefore gave quotations from Darwin and Herbert Spencer.

INTELLIGENCE IN THE BEAR.—*Nature* contains the following anecdote, contributed by J. M. Hayward, of a bear in Russia: "The following was narrated to me by Mohl's brother, on whose estate it took place. The carcass of a cow was laid out in the woods to attract the wolves, and a spring trap was set. Next morning the forester found there the track of a bear instead of a wolf on the snow; the trap was thrown to some distance. Evidently the bear had put his paw in the trap and had managed to jerk it off. The next night the forester hid himself within shot of the carcass to watch for the bear. The bear came, but first pulled down a stack of firewood cut into seven-foot lengths, selected a piece to his mind, and taking it up in his arms, walked on his hind legs to the carcass. He then beat about in the snow all round the carcass with the log of wood before he began his meal. The forester put a ball in his head, which I almost regret, as such a sensible brute deserved to live."

ANTHROPOLOGY.¹

UNIFORM CRANIOMETRY.—In September, 1877, a craniometric conference was held in Munich (*Correspondenzblatt*, 1878, No. 7), and a second conference in August, 1880, in Berlin (*Correspondenzblatt*, Bericht über die XI., Allg. Versamml., pp. 104-106). At the thirteenth general meeting at Frankfort, August, 1882, a perfected scheme was proposed. This is published in *Archiv für Anthropologie*, xv, pp. 1-8, 1884, and signed by sixty-seven of the most eminent anthropologists in Germany, Switzerland, Austria, Italy and Russia.

The Horizontal.—The line selected for the horizontal of the skull is that extending from the lower edge of the orbital cavity to the middle of the ear cavity or the upper edge of the internal meatus.

The linear measures of the cranium are 16; of the face, 15. The capacity of the skull is taken with shot, if possible. The cranial indices are as follows:

Dolichocephaly.....	.75 and under.
Mesocephaly.....	.751-.799.
Brachycephaly.....	.80-.85
Hyperbrachycephaly.....	.851 and over.

¹ Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Chamæcephaly70 and under.
Orthocephaly701-75
Hypsicephaly751 and over.
Prognathy	to 82°
Mesognath or orthognathy	83°-90°
Hyperorthognathy	91° and over.

Other indices are based on the height of the face, orbital cavity, nasal cavity, and palate.

The following table is drawn up for the purpose of indicating the manner of reporting measurements:

		Number		
		Age	Sex	Source
		C Capacity		Cranium
		L Length		
		B Width		
		B ¹ Width of forehead		
		H Height		
		OH Height of ear		
		LB Length of skull base		
		N Horizontal circumference		
		S Sagittal circumference		
		Q Lateral circumference		Face
		GH Height of face		
		G ¹ H Height of upper face		
		GB Width of face		
		J Zygomatic width		
		NH Height of nasal cavity		
		NB Width of nasal cavity		
		O ₁ Width of orbit		
		O ₂ Height of orbit		
		G ₁ Length of palate		Indices
		G ₂ Width of palate		
		PL Facial angle		
		L : B Length and height		
		L : H Length and height index		
		B : H Breadth and height index		
		GH : GB Face		
		G ¹ H : GB Upper face		
		NH : NB Nose		
		O ₁ : O ₂ Orbital cavity		
		G ₁ : G ₂ Palate		
		Remarks		

ETHNOLOGY OF BRITISH GUIANA.—On the 1st of June, 1882, appeared the first number of a semi-annual journal, published in Demerara, bearing the following title: *Timihri*: being the journal of the Royal Agricultural and Commercial Society of British Guiana. Vol. 1, Pt. 1, June. Edited by E. F. im Thurn, and published by J. Thomson. The fifth number has recently been published, bringing the journal up to date. Mr. im Thurn also published, in 1883, "Among the Indians of Guiana," being sketches

chiefly anthropologic, from the interior of British Guiana, with fifty-three illustrations and a map. London, Kegan Paul, French & Co., pp. 445, 53 ill., map. Let us look first at *Timehri*. The word *Timehri* or *Timeneeri* is Carib for certain marks on rocks, corresponding to our pictographs, found throughout Guiana. The papers containing ethnologic matter will be given by title:

E. F. im Thurn. Tame animals among the Red men of America (I, 25). [The Indians of Guiana find means to tame nearly all the wild animals of the country, not for love of pets, but to increase their wealth. They even know how to change the color of parrots from green to yellow. At one house the writer saw parrots, macaws, trumpet birds, troupials, monkeys, toucans, curassow birds, a sun bird and many others. Monkeys are abundant in some settlements, deer of two sorts are sometimes tamed, as well as peccaries, quashies, jaguars, tapirs, labbas, water-hogs, acouries, ducks, troupials, bell-birds, hawks, owls, herons, plovers, cock-of-the-rock and iguanas.]

West Indian Folk-lore, I, 145.

E. F. im Thurn. Notes on West Indian stone implements, I, 257-271, II, 252-264 [The implements described are polished celts, large ornamented axes and mamiform stones.]

The Di-di or water mamma, I, 298.

Indian privileges, I, 306.

Couvade, I, 310-314; II, 159, 355.

Jonah myths, II, 161.

Local medicinal barks, II, 348.

Still more interesting is the volume by Mr. im Thurn entitled "Among the Indians of Guiana." The first five chapters (p. 1-155) relate chiefly to the geography and natural productions. The rest of the volume describes minutely the tribes, marriage systems, dress, houses, social life, arts, feasts, religion and antiquities.

The following tribal names occur:

Branch or Stock.

Ackawoi	Carib.
Amaripas	Wapiana.
Arawaks	Arawak.
Arecuna }	Carib.
Arecuma }	
Atarois	Wapiana.
Caribisi } same	Carib.
Caribs }	
Carinya, Caribs call themselves (people).	
Cobrungrus, hybrids between Indians and Negroes.	
Daurais, same as Atarois.	
Engaricos, hybrids between Macusis and Arecunas.	
Kapohn, Ackawois call themselves (people).	
Lokono, Arawaks call themselves (people).	
Macusi	Carib.
Maiongkongs, beyond the British border.	
Maopityans, unclassified.	
Nikarikarus, hybrids between Macusis and Brazilians.	
Paramona } same, sub-tribe of Ackawoi	Carib.
Partamona }	
Pianoghotto, sub-tribe of Macusi	Carib.
Piriana, beyond the British border.	
Pshavaco, hybrids.	
Taruma, common vocabulary with Maopityans.	
Taurais, same as Atarois.	

Waccawai, same as Ackawoi.

Branch or Stock.

Wapiana..... Wapiana,

Warrau..... Warrau.

Woruma, hybrids.

Woyowai, only the name is known.

Zurumutas, sub-tribe of Macusi..... Carib.

To give a faint conception of the rich veins of ethnologic lore in this volume it would be necessary to quote many pages. We have so few collaborators in South America, that Mr. im Thurn is to be congratulated for his energy and wise use of his time.

THE CATLIN COLLECTION.—The editor of these notes had the painful pleasure of unpacking the last of George Catlin's magnificent collection a few days ago. Among a multitude of articles of dress, industry and ornament, many are in good state of preservation, having the merit of being collected forty years ago and taken from the hands of those who made and used them. But, sad to tell, time, neglect and insects have played dreadful havoc with many beautiful and rare things. It was hard to realize that so few years could work such changes, yet such is the case, and many more fine collections will go the same path.

MICROSCOPY AND HISTOLOGY.¹

METHODS OF IMBEDDING.²—Dr. Blochmann reviews the various methods of imbedding, describing in detail those that have come into general use, and pointing out the advantages and disadvantages of each.

In every method of imbedding the principle is the same, namely, to saturate objects with substances which not only fill out the larger internal cavities, but which also penetrate the tissues themselves, rendering them (after cooling) sufficiently hard for the process of sectioning.

Glycerine and Gelatine.—

Gelatine..... 1 part.

Distilled water..... 6 parts.

Glycerine..... 7 parts.

For preservation a little carbolic acid (1 gram for 100 grams of the mixture) should be added. Objects are transferred directly from water to the melted mixture; and, after complete saturation, imbedded in paper boxes. After cooling the objects thus imbedded are hardened in alcohol, then sectioned and mounted in glycerine.³

*Schaefferdecker's method of imbedding in Celloidine.*⁴—Celloidine

¹ Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

² F. Blochmann. "Ueber Einbettungsmethoden." *Zeitschr. f. wiss. Mikr.*, I, H. 2, p. 218, 1884.

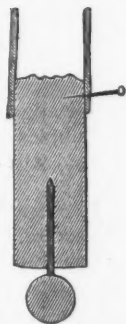
³ This method is recommended by Kaiser. *Botan. Centralbl.*, I p. 25, 1880.

⁴ *Arch. f. Anat. u. Phys.*, I Abth., p. 199, 1882.

is prepared in plates, and may be obtained from Wittich & Benkenndorf, Chaussee Strasse 19, Berlin N.

Schiefferdecker uses two solutions, one of a syrupy consistency, the other somewhat thinner. The celloidine plate is cut into small pieces and dissolved in absolute alcohol and ether (in equal parts). Objects are transferred from absolute alcohol,¹ first to the thinner solution, then to the thicker. After remaining a few hours (or days, according to the character of the object) in the latter they are imbedded in paper boxes. As soon as a hardened film forms on the solution in the box, the whole is placed in 82 per cent alcohol for 24-48 hours, and thus rendered sufficiently hard for cutting.

Blochmann recommends imbedding on a cork rather than in a paper box, as less celloidine is required, and as the cork is held more firmly in the holder. One end of the cork is made rough and surrounded by a strip of paper, which is made fast by a pin, as shown in the figure. The roughened surface of the cork is wet with absolute alcohol and then the object imbedded in the usual manner. In order that this small box may sink in alcohol, in which it is placed for hardening the celloidine, it may be weighted with a small lead ball fastened to the cork by a needle (see figure).



In cutting, the knife is kept wet with alcohol (70 per cent). The sections may be placed in water or in alcohol, and afterwards stained with carmine or hæmatoxylin, in which the celloidine is only a little or not at all, stained. Aniline dyes color the celloidine, and therefore should not be used.

The sections can be mounted in glycerine or in balsam; but in the latter case they must be anhydrous with 95 per cent alcohol, as absolute alcohol dissolves the celloidine. They should be clarified in bergamot oil or origanum oil (clove oil dissolves the celloidine).

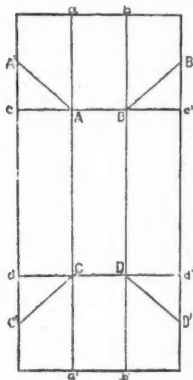
Objects imbedded in celloidine can be preserved, ready for cutting, for a long time in 70-80 per cent alcohol.

Imbedding in Paraffine.—The object is transferred from absolute alcohol to chloroform, and left till the alcohol has been entirely replaced; it is next placed in a shallow vessel with a small quantity of chloroform, and enough paraffine added, in fine pieces, to cover it after the chloroform has evaporated. The vessel is then exposed to a temperature which corresponds to the melting point of the paraffine employed. The paraffine melts and the chloroform evaporates, so that the object is brought very gradually into pure melted paraffine. In this way the object becomes completely saturated with the paraffine.

¹ If the objects are penetrated with difficulty, they may be transferred from absolute alcohol to ether, then to the celloidine solutions.

It is essential that the mixture be kept at the proper temperature until *all* the chloroform has evaporated. A simple test is to place a hot wire in the paraffine, if no bubbles arise, it is safe to conclude that the chloroform has entirely escaped.

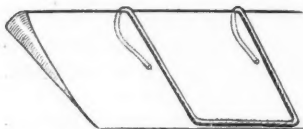
After evaporation of the chloroform, the object may be placed in any desired position, and the paraffine allowed to cool. After cooling the object can be cut out and fixed to a larger block of paraffine fitted for the holder of the microtome.



Boxes for imbedding may be made of rectangular pieces of paper of the thickness of postal cards in the following manner: The paper is first broken in the lines $a a'$ and $b b'$, then $c c'$ and $d d'$ (by bending always towards the same side). Then in every corner a break ($A A'$, $B B'$, $C C'$, $D D'$) is made by bringing $A c$ and $A a$ together. The four sides of the box are next bent up and the corners at the same time turned outward and back behind the ends $A B a b$ and $C D a' b'$. Finally the upper edge of these ends is bent down over the corners.

Bubbles around the object may be removed by means of a heated wire.

A SIMPLE SECTION-SMOTHER.¹—Led by a suggestion of P. Francotte, the writer devised a simple form of section-smother which can readily be made by any one and which fairly answers the purpose for which it was intended. A piece of iron wire is



bent in the manner shown in the cut, so that the two ends will form a spring clip grasping the back of the knife. The middle portion is so fixed that it will be parallel with the edge of the knife and at

a distance of about a hundredth of an inch from it. For this purpose the writer has found an ordinary hairpin, deprived of its lacquer, about the right size.

In cutting, the section passes between the wire and the blade and all tendency to curl is prevented. This form of smother is applicable to the knife when used in any form of sledge microtome, or when cutting free-hand; but for use with the Sterling (well) microtome it is evidently ill adapted, for the ends which come underneath the blade would interfere with the work. The form of smother recently described by Drs. Gage and Smith embraces the same principle but is more complicated.

¹ J. S. Kingsley, *Science Record*, 11, No. 5, p. 112, March 15, 1884.

ON THE USE OF VASELINE TO PREVENT THE LOSS OF ALCOHOL FROM SPECIMEN JARS.¹—The petroleum preparation known as vaseline is known to be practically unaffected by ordinary temperatures and by most substances. In the *Journal of the Chemical Society*, July, 1882, p. 786, it is said to be "sparingly soluble in cold strong alcohol, and completely in hot, but separates out on cooling." After trying various substances, wax, paraffine, oil and glycerine with but partial success, the use of vaseline was suggested by the two authors independently and nearly at the same time. The experiments tried this spring indicate that, during three months, at ordinary spring and summer temperatures, there is no appreciable loss of ninety-five per cent alcohol from glass vials or jars, whether upright or inverted or on the side, provided corks are anointed on the bottom as well as on the side, provided ground glass stoppers are anointed and firmly inserted, and provided the rubber rings of fruit jars and the specimen jars made by Whitall, Tatum & Co., are anointed on both sides and the covers well screwed down.

We have also used the vaseline for preventing the loss of other liquids, excepting chloroform and spirits of turpentine; as a lubricator of drawers, and to prevent the sticking of the covers or stoppers of cement vials; and for the prevention of rust upon steel instruments.

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SCIENTIFIC NEWS.

— Prizes given by the French Academy (continued from p. 752, July No.).—The grand prize in geology was given to M. Fontannes for his studies of the Tertiary basin of the south-east of France, carried on by him with great ardor for ten years. Thanks to him the newer formations of the valley of the Rhone are now among the best known regions.

A second prize of 2000 francs fell to M. Peron for his "Geological Description of Algiers."

The "Prix Barbier," for an important discovery in surgical, medical or pharmaceutical science, was allotted to M. J. Chatin for his researches upon the trichina. His work is a complete monograph, reviewing all previous published works upon the worm and adding many new facts.

In botany the "Prix Desmazieres" was awarded to the memoir of MM. G. Bonnier and L. Mangin, entitled "Researches on the respiration and transpiration of Fungi." This work marks a great advance both in the special physiology of fungi and in general physiology.

An "encouragement" of 500 francs was accorded to M. Klein for his memoirs on "Vampyrella" (which he places near the Myxomycetes) and on the "Crystalloids of marine Algæ."

¹ Wilder and Gage. *Proc. A. A. A. S.*, xxxii, p. 318.

The Fons-Melicocq prize for the best work upon the botany of the north of France, was not awarded, but an "encouragement" was given to M. Ch. Magnier for the ensemble of his works.

The "Prix Bordin" for the best work upon the influence of the environment upon the vegetative organs; the changes undergone by terrestrial plants when grown in water, and by aquatic plants grown in air; and the causes, as ascertained by direct experiment, of the special forms of some species of the maritime flora, was allotted to M. Costantin, whose memoir, the result of three years of labor, contributes largely to the development of experimental anatomy. Two other anonymous works were submitted, and to the one of these bearing the motto, "*Hoc opus, hic labor est*," a prize of 1000 francs was given.

The "Prix Morogues," to be given every decade for the work which during that term may have been most beneficial to the progress of agriculture in France, was awarded to the "Biological Chemistry" of M. Duclaux, forming part of the "Chemical Encyclopædia" published by M. Fremy. In giving this award especial notice was taken of the author's researches upon milk, without losing sight of the fact that his labors were carried into almost all agricultural industries.

For the "Grand Prix" in anatomy and zoölogy, to be given to the best memoir upon the histological development of insects during their metamorphosis, M. Viallanes was the only applicant, but his work was of such excellence that the prize was unanimously decreed to be his.

The "Prix Bordin," for researches in botanical or zoölogical palæontology in France or Algiers, was awarded to M. Grand-Eury, for his two works entitled, "*The Carboniferous Flora of the department of the Loire and the center of France*," and "*On the formation of Coal*."

The "Prix Savigny," for young traveling naturalists, was not given, neither was the "Prix Thore."

The Montyon prizes in medicine and surgery were three, each of the value of 2500 francs, and were decreed to Dr. Constantin Paul for his treatise upon "*The diagnosis and treatment of diseases of the Heart*;" to Dr. H. Roger for his "*Clinical researches upon the diseases of Infancy*;" and to Dr. E. Vallin for his treatise on "*Disinfectants and Disinfection*."

Prizes of 1500 francs were given to Doctors H. Napias and A. J. Martin for their treatise upon "*The study and progress of hygiene in France*;" to Doctors L. Dubar and Ch. Remy for their memoir on "*Absorption by the Peritoneum*;" and to the "*Treatise upon Uterine Inversion*" of Dr. P. Denuce. Honorable mention was given to six other works.

The Breant prize was awarded to Dr. Fauvel for his work upon the etiology and prophylaxy of cholera, a continuation of the labors which gained him the same prize in 1870. The sum of

10,000 francs was divided among the four pupils of Pasteur, M. Strauss, Roux, Nocard and Thuillier, who composed the commission which in the past year studied the cholera on the spot in Egypt. The last gentleman fell a victim to his devotion to science and humanity.

The "Prix Godard" was decreed to Dr. Guelliot for his monograph on the "Anatomy, Physiology and Pathology of the Vesiculæ Seminales." Honorable mention was made of the work of Dr. Desnos on lithotripsy.

The "Prix Chaussier" was given to Dr. Legrand du Saulle for his "Medico-legal studies of epileptic and hysterical subjects." These four volumes, both in France and abroad, are constantly cited as authority upon the legal aspects of emotional insanity.

Honorable mention was made of the remarkable work of M. A. Layet on the "Hygiene and maladies of the Peasantry" and to M. A. Luton for his work on special and general therapeutics.

The "Prix Lallemand" was not awarded, but its value was divided between M. B. Ball, author of "Lessons on Mental Diseases," and M. Aug. Voisin for his "Clinical lessons on mental and nervous Maladies."

The Montyon prize in physiology was awarded to Dr. P. Reyard for his experimental researches on the pathological variations in respiratory combustion; and the "Prix Lacaze" was given to M. Balbiani for the total of his works upon embryogeny and general physiology during the last twenty years.

The "Prix Pénard," for ærostation, was parted into three equal portions, and given to MM. Gaston Tissandier, Duroy de Bruignac and V. Tatin.

Among the general prizes the "Prix Tremont" was decreed to M. J. Morin for his mechanical inventions; the Gegner prize was divided between MM. Ed. Lescarbault and Ch. Brame; the "Prix Petit d'Ormoy" (mathematical sciences) was given to M. Gaston Darboux; the "Prix Petit d'Ormoy" (natural sciences) was unanimously awarded to M. Henri Filhol for his researches among the Tertiary mammals of France; and medals of honor from the Petit d'Ormoy funds were given to the various members of the *Talisman* exploring expedition, and to those who, in 1883, formed part of the French expedition to Cape Horn in the *Romanche*.

The "Prix Laplace" is each year the prize of the first scholar of the Ecole Polytechnique, and thus fell to M. A. C. Rateau.

—We have received from Dr. Henry C. Chapman an interesting brochure entitled "History of the Circulation of the Blood," in which he concludes that the discovery of the circulation of the blood belong to no one age, country or person. Its history, extending over a period of 2000 years, attracted the attention of the great medical minds of all time. "Such a history ought to encourage every student, for however trivial and unimportant his

experiments or observations may appear at the time, every new fact once well established will sooner or later assume its appropriate place as a part of some future generalization; the chain of facts leading to a great discovery being united together like living things, each linked, those that have passed away with those still to come."

— Two Japanese naturalists, I. Iijima and C. Sasaki, have published in English an appendix to Memoir, vol. 1, part 1 of the Science Department of the University of Tokio, on the Okadaira shell mound at Hitachi. The contents of this mound are compared with those from the Omori shell mounds described and figured by Professor E. S. Morse. The pottery, stone and horn and bone implements are of the same primitive nature as those from the Omori mound. Among the great quantity of bones only a single human one was detected. This was a femur roughly broken off at each end, and from the fact that it was broken in the same way as the bones of other mammals, the authors suggest that it might be taken as an evidence of cannibalism. Bones of the ox also occurred, which are regarded as "cases of intrusion unless we suppose the wild ox has existed in Japan." The illustrations are well drawn and printed by Japanese artists.

— The Zoölogischer Jahresbericht for 1882, IV, abtheilung, vertebrata, has been lately received (June 23). It forms a volume of 300 pages, and has the same excellencies as have characterized its predecessors, *i. e.*, the full abstracts of articles and works of a general nature, as well as matter pertaining to systematic zoölogy.

— The French Société d'Acclimatation has awarded the gold medal offered by the minister of agriculture to Dr. Dareste, the famous embryologist, for his researches in artificial incubation.

— Alphonse Lavallée, head of the very extensive arboretum at Segre, near Paris, died in June last at the age of forty-nine. He was the leading European collector and student of trees, and the author of the Arboretum Segrezianum; his latest work was an illustrated monograph of the large flowering Clematis, while at the time of his death he had nearly ready for the press, an illustrated monograph of the genus Crataegus.

— A brief memoir of the late Dr. Hermann Müller of Lippstadt, has been written by Ernst Krause, the proceeds of the sale of which are to be added to the "Müller Fund." The brochure contains an excellent autotypic portrait of the deceased, and the memoir is accompanied by a chronological list of Müller's writings.

— The death is announced at Breslau of the well-known botanist and palæontologist, Dr. Göppert, in his eighty-fourth year.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, May 31.—Communications were read by Mr. James E. Benedict on the recent cruise of the steamer *Albatross* in the Gulf of Mexico and Caribbean sea; by Ensign E. E. Hayden, U.S.N., on a new method of figuring fossil leaves and other objects by the aid of photography; by Mr. John A. Ryder on the development of viviparous minnows; and by Mr. Romya Hitchcock on a collection of Foraminifera belonging to the genus *Lagena*.

NEW YORK ACADEMY OF SCIENCES, June 2.—A new process of cutting intaglios and cameos, so as to produce the finer effects of the ancient glyptic work, illustrated with specimens and with the present and the proposed machinery, was described by Mr. George F. Kunz; Mr. Edward W. Martin remarked on photo-micrography, processes and results, with illustrations.

June 9.—The scenery of the Rocky Mountain parks was described by the president with a series of lantern illustrations.

APPALACHIAN MOUNTAIN CLUB, June 11.—The following papers were presented: Notes taken on a recent trip to Black and Koan mountains, N. Carolina, A. E. Scott; A trip to the Sourdnhunk mountains, near Ktaadn, Geo. H. Witherle; The mountains near Lakes Willoughby and Memphremagog, C. E. Fay, J. R. Edmands.

OTTAWA FIELD NATURALISTS CLUB.—During 1882 and 1883 this society has given five soirées, at which the following papers were read: No. 1, December 6, 1882, "President's inaugural address," J. Fletcher; No. 2, January 19, 1883, "The Laurentian system," F. D. Adams, and report of the Mineralogical branch; No. 3, "The fresh-water fishes of this vicinity," N. B. Small, and report of the Conchological branch; No. 4, "Notes on and description of some fossils from the Trenton limestone," W. R. Billings; "A note on *Triarthrus spinosus* Billings," H. M. Ami; report of the Palæontological branch and report of the Ornithological and Zoological branch; No. 5, "The ducks of this locality," W. P. Lett; report of the Botanical branch and report of the Entomological branch.

Three excursions were held during the season of 1883: To King's Mere on 8th June; Deschene's mills on 2d September and Brigham's quarries on 21st October.

The council caused to be printed the transactions (No. 3) of the club for the year 1881-'82, consisting of sixty-six closely printed pages and two excellent plates. The transactions contain, in addition to the papers and reports read before the club, a list of the birds so far recorded from this locality.

AMERICAN PHILOSOPHICAL SOCIETY, April 18.—Extract from a Report on the Ham's Fork coals of Wyoming Terri-

tory, by P. W. Sheaffer, were read. Mr. Lesley exhibited models of the Nittany valley and Bald Eagle mountain, and of the Jones mine, made by Mr. Harden. Dr. Hunt gave an account of his examination of the Jones and other iron mines, and assigned them all to the horizon of H. D. Rogers' primal slates, though they lie in immediate contact with the Trias. Dr. Frazer said that facts show that some of the mines penetrate the Trias, yet the triassic iron-ore deposits may be merely the redeposited detritus of more extensive primal slate iron ores.

May 2.—Mr. Phillips made a communication "On a supposed Runic inscription near Yarmouth, N. S.," and exhibited a photograph and a squeeze from it. Mr. Ashburner exhibited recently printed sheets of cross sections made by the Geological Survey in Schuylkill and Lucerne counties, and explained some of the peculiarities of structure.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Feb. 21.—Mr. Meehan described an abnormal *Halesia tetraptera*, with separate petals and leaves like those of the apple. The plant grew under similar conditions to numerous other normal seedlings and was the offspring of the same tree. Mr. Lockington considered this a case of reversion. Professor Heilprin exhibited specimens of carboniferous fossils, with Phillipsia, and along with them an ammonite, the oldest yet discovered, which he named *Ammonites parlaii*.

Feb. 28.—Dr. Leidy directed attention to specimens of a *Distoma* from the mouth of the alligator. *Distoma oricola* was proposed as the name. Examples of *Filaria horrida*, from the throat of the American ostrich, were shown, and also some filariæ from the marsh owl. The last accorded so closely with the *Filaria labiata* of the black stork of Europe and North Africa, that the speaker believed them to be the same species. Dr. Randolph detailed the results of experiments upon the digestion of boiled and unboiled milk, and announced his conclusion that the latter had the advantage as a nutrient.

March 3.—Dr. Leidy stated his belief that the species of *Apsilus dictyophora*, and *Cupelophagus* described by himself and others were really but one species. Miss Foulke maintained the distinctness of the forms described by Forbes and Meznichow, and described *Trachelius leidyi*, a ciliate infusorian found in Schuylkill water. Dr. McCook described the cocoons of the few species of orb-weaving spiders which make more than one cocoon.

March 13.—Mr. Ford exhibited specimens of *Zirphæa crispata* found in driftwood at Atlantic City. Professor Heilprin recorded the finding of *Porpita linnæana* near Cape May, and Mr. Tryon remarked that in 1876 he found an example at Atlantic City. Mr. Potts stated that the stems of *Urnatella* on the dry sponge-crust collected by him at Fairmount had commenced to show signs of life.

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